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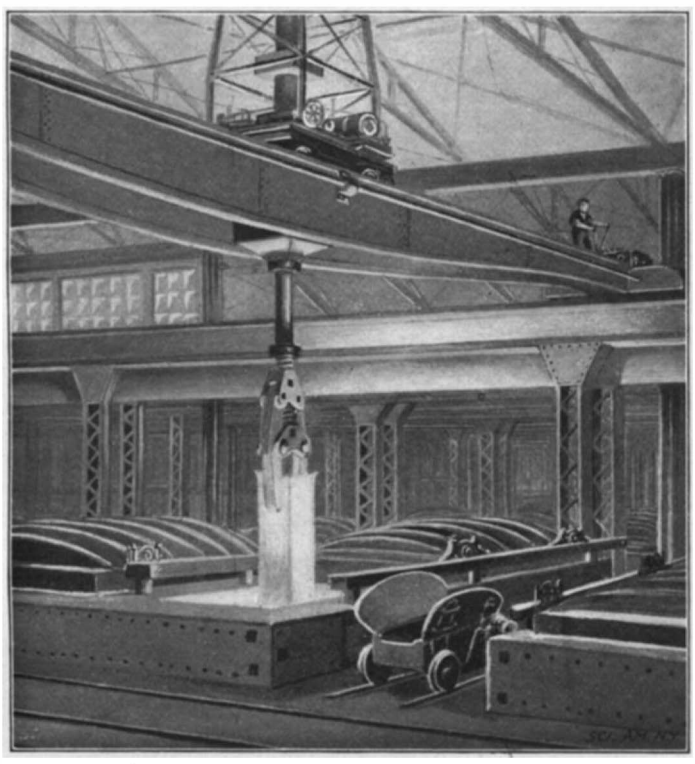
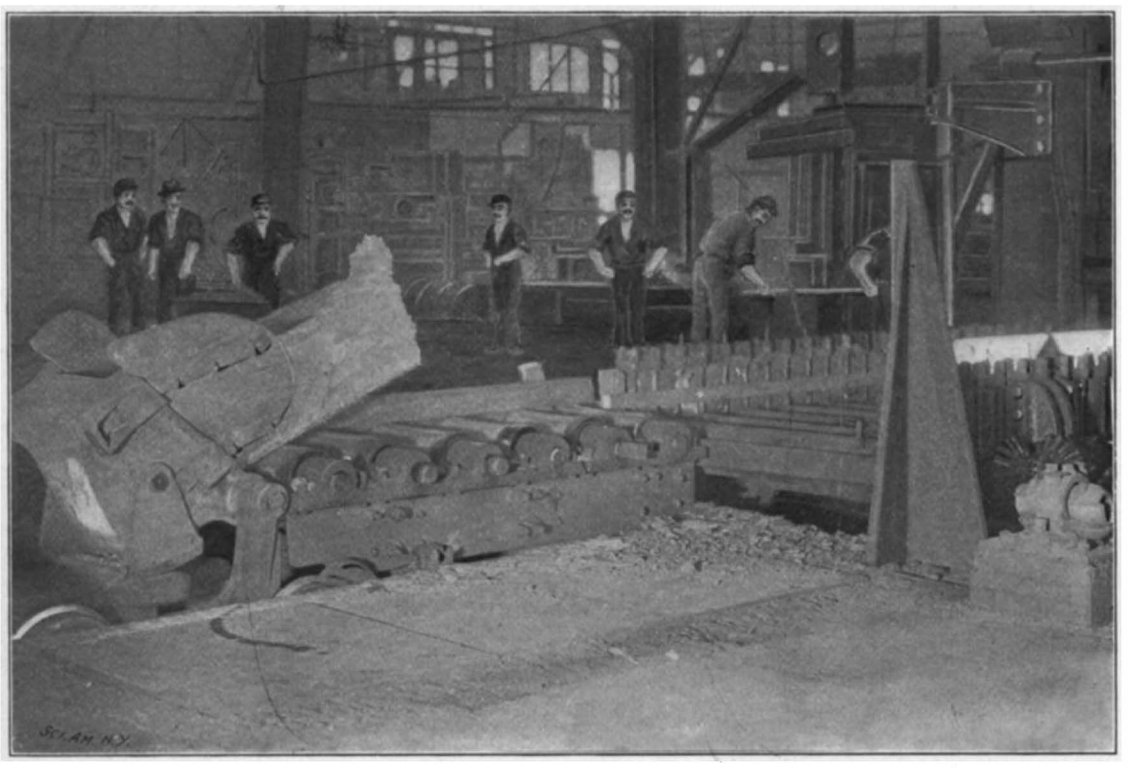
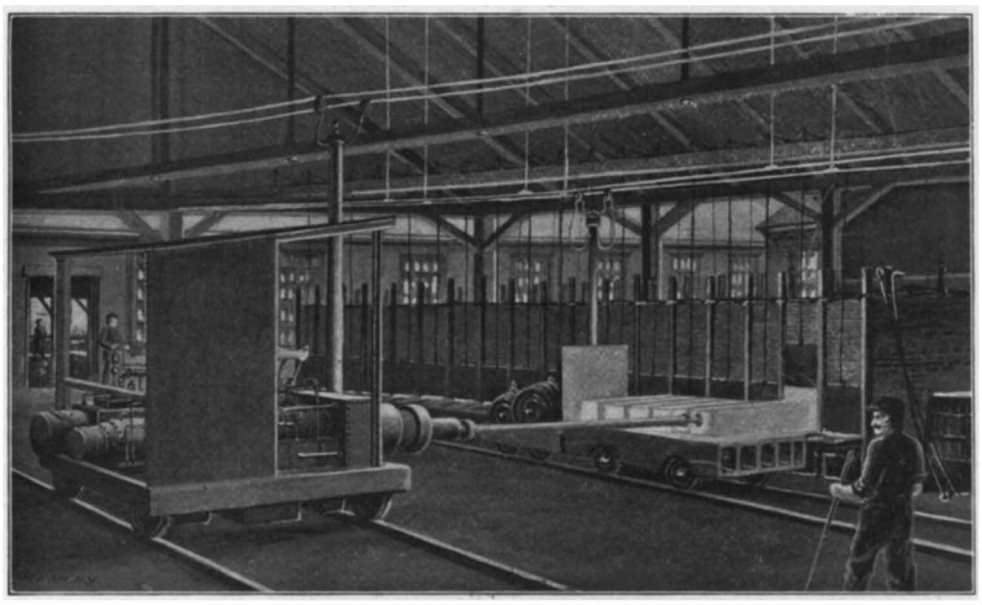


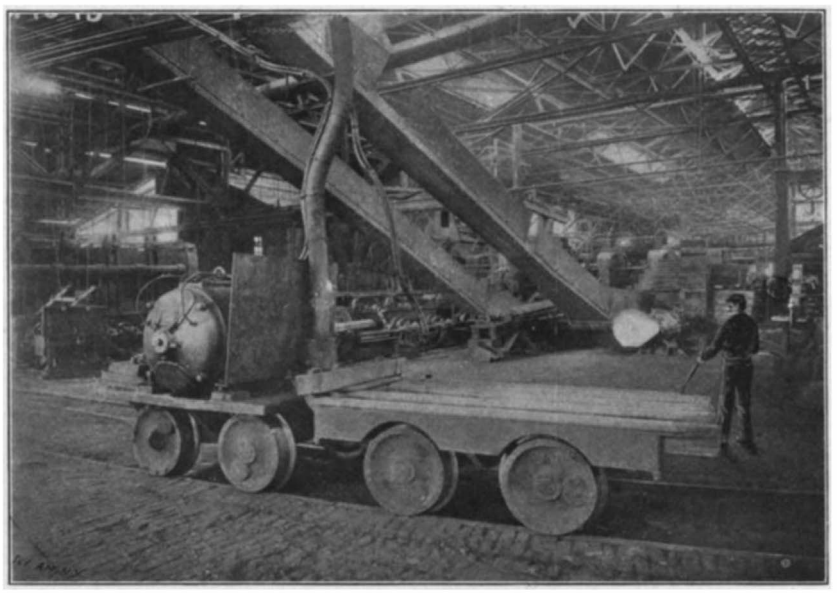
Withdrawing Heated Ingot from "Soaking Pit."



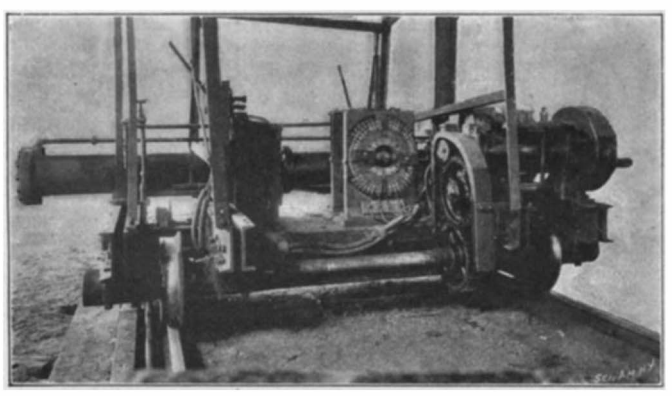
Discharging Ingot from Car to Feed Rollers of Mill.



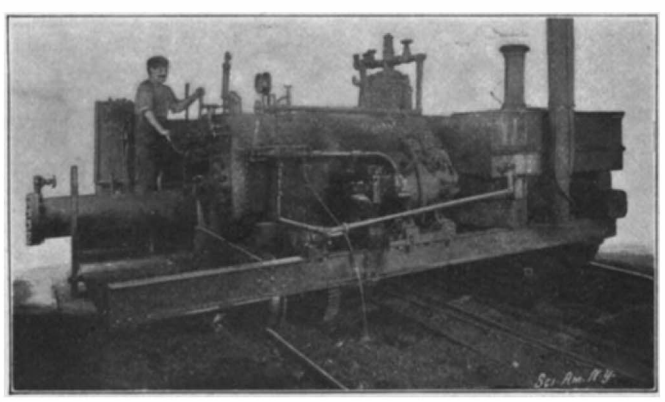
Bloom-Charger Thrusting Blooms Into Re-Heating Furnace.



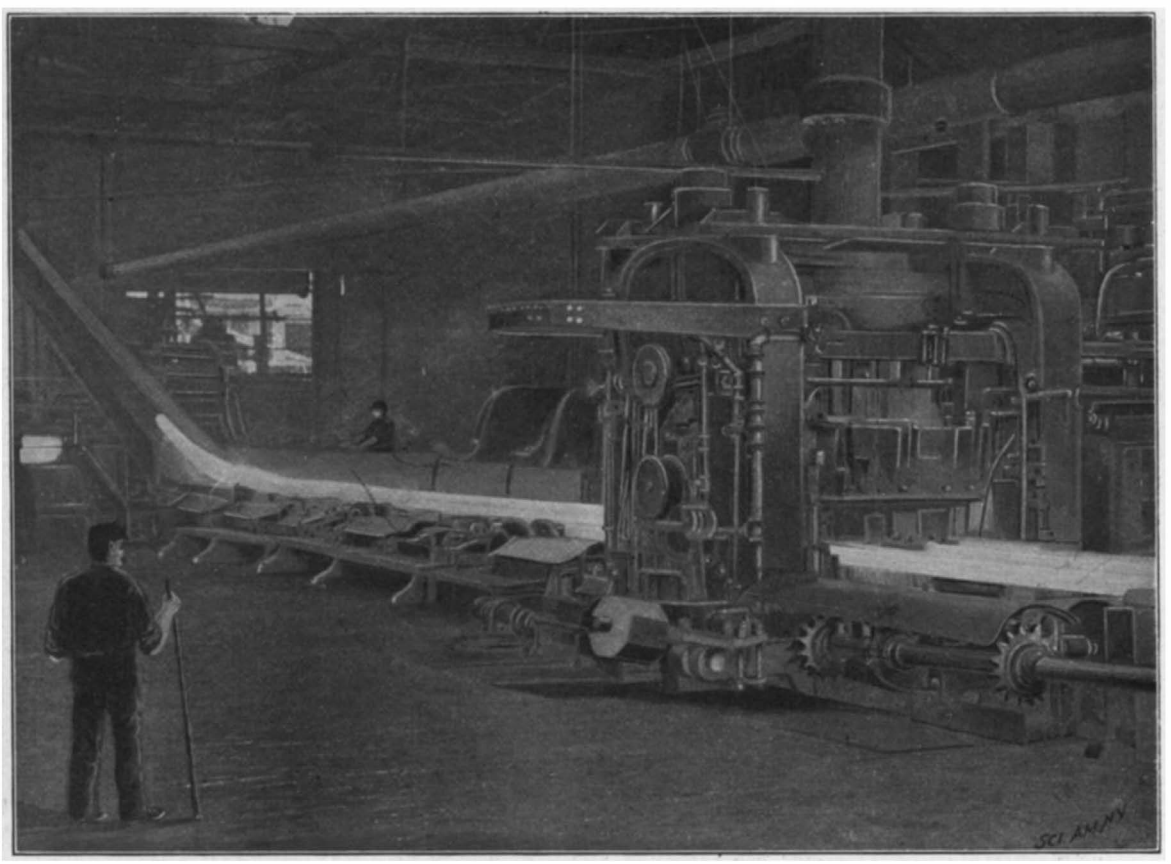
Bloom-Carriage and Motor for Transfer of Blooms.



Charging Machine No. 2 Rail Mill.

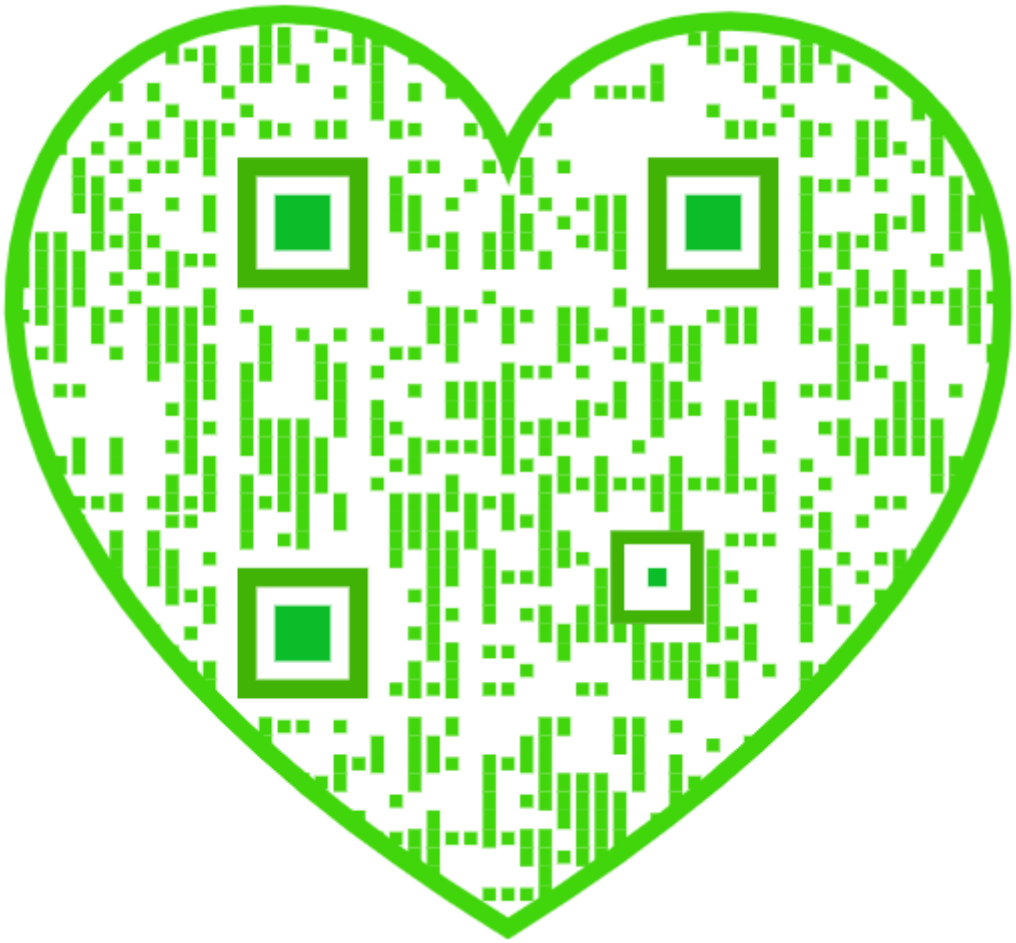


Charging Machine No. 1 Rail Mill.



Rolling One Hundred Pound Rails.

MANUFACTURE OF STEEL RAILS—II.—[See page 346]



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NEW YORK, SATURDAY, MAY 17, 1902.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

OUR VAST STEEL INDUSTRY.

The public has an idea that the United States Steel Corporation does business in a very big way; but the figures of its operations for a single year will probably be a matter of surprise, even to that part of the public which is more or less familiar with the magnitude of our steel industry. The figures recently presented by the president to the directors show that the trust paid out during its first year, in wages alone, the sum of $112,899,198. The cost of manufactured goods turned out by this vast aggregation of furnaces and mills was $343,000,000, and the selling price was approximately $459,000,000. These results show by simple subtraction the enormous profits of $116,000,000, from which has to be deducted, according to the customary Carnegie methods, the cost of maintenance, which is estimated for the whole plant concerned at a total of $24,541,689. The average number of employés during the year was 158,263, and their labor resulted in a total production of steel which is twice as great as that of Great Britain, and six times as great as that of France. In spite of these vast outputs and princely profits, the president stated that orders are booked for nearly twelve months ahead, and that the prospects for the coming year are even better than were those of the year just closed. That the past year has been a favorable one not merely to capital but to labor as well, is shown by the fact that the average wages paid by the steel combination is $712 per year, or approximately $2.25 per working day.

THE STATIONS OF THE RAPID TRANSIT SUBWAY.

The fear has been expressed that the local station platforms of the Rapid Transit Subway have not been planned on a sufficiently generous scale to accommodate the crowds that will flock to the new road as soon as it is opened, to say nothing of the increase in travel which will result from the steady growth of the city. We have no doubt that in planning the Subway, the Commissioners and their engineers gave careful consideration to this subject, and it is probable that in the case of the stations located in the more important centers, such as City Hall Park, Forty-second Street and the Circle at Fifty-ninth Street, ample provision for present and future needs has been made. The City Hall Park station, for instance, is one hundred and fifty feet wide by nearly four hundred feet long and contains four spacious platforms; a few hundred yards distant on the loop is another station where the platform will be two hundred and fifty feet in length, while the other more important stations on the Subway are of equally generous proportions. It is in the local stations that there would seem to be danger of crowding; for the standing room is of such restricted width that, should there be any blockade of the trains, the platforms, especially in the rush hours, would quickly become congested. With the discomfort occasioned by the narrow width of the Elevated stations in mind, the Rapid Transit Commission should see to it that platforms are made as commodious as the width of the streets will allow, even if they have to be carried beyond the building line. Rather than have to go to the great trouble and expense of making subsequent extensions, it would be better to build the local stations a little larger than is necessary to meet the immediate demands of the service at the opening of the line. If the road is to be pre-eminently a rapid-transit system, the quick access of passengers to the cars should be facilitated by every possible means, so that stops at stations may be as brief as possible. One of the surest ways to do this is to provide ample depth of platform for the incoming and outgoing streams of passengers as they approach and leave the cars.

ELECTRICITY OR STEAM FOR HIGH-SPEED RAILWAYS

In a report from our consul-general at Berlin on the recent high-speed electrical railway tests which were carried out between Berlin and Zossen, attention is drawn to the fact that although five months have passed since the rather sudden close of those experiments, absolutely no official report on the subject has yet been made. Furthermore, even the Studien Gesellschaft or specially organized company, under whose management and by whose support the experiments were conducted, has not prepared any official report for the information of its own members. Nor has it yet been decided when, if at all, the trials shall be resumed. The nearest approach to an official verdict was a paper recently read before an association of railway experts by the engineer who represented the government at the trials, which were carried out on a stretch of military railway line.

The line, 17.4 miles in length, was laid with 69-pound rails upon metal ties. The track, which had been in use for a number of years, was prior to the experiment put into perfect repair. At ordinary speeds it seems that everything worked to perfection, both on cars and track; but as a speed of 81 miles an hour was approached and exceeded, new and serious conditions were encountered. Both the rails and the ties proved to be too light for the strains. The track began to give way, and the side sway of the cars increased to a serious degree. The highest speed claimed was 99.4 miles per hour. As the announced purpose of the trials had been to make test speeds of from 125 to 150 miles an hour, the results have naturally caused a chill of disappointment among electricians in Germany; not, indeed, because of any failure of the electrical system as such, for the trials have proved that a polyphase alternating current carried on triple overhead wires and taken off by trolleys, could be led, at the high potential of 10,000 volts, into the flying car, and there transformed to a lower working pressure at which it was used in the motors. There is no question, indeed there never was any question in the minds of electrical experts, that the current could be got into the car for any speed that might be desired.

The disillusionment and acute disappointment is due to the fact that the failure of the specially prepared track proves that the greater proportion of the German railways cannot be adapted to high-speed electrical traction without being practically rebuilt. Although some of the leading lines have been relaid with 95-pound rails, many of the principal and all of the secondary railways are laid with rails of the old standard which failed so completely when the motor car exceeded the speeds which have been approximated on steam railroads. As Consul-General Mason pertinently remarks: "The Prussian state railways are conservatively and economically managed; they yield a large and steady revenue which the royal treasury needs from year to year, and it is clearly seen that any scheme of rapid long-distance transit which would require the state lines to be torn up, their curves straightened and their tracks relaid with heavier rails, will have long to wait." It is suggested that it is, as a more or less direct corollary to all this, that the German Society of Mechanical Engineers has once more taken up the high speed problem, and at a recent meeting voted a series of prizes for the first, second and third best designs for a steam locomotive and train which would be designed to form a unit in a scheme of rapid, long-distance passenger service. The engine must be capable of hauling a 180-ton train over a level track at a speed of 75 miles an hour for three hours without stopping. The cars are to be so designed as to form trains of three or four cars, each capable of carrying a hundred passengers and their baggage, with full provisions for food, drink and every necessary comfort during a journey of five to ten hours.

With regard to the high-speed railroad trials, while we sympathize with the German public in their disappointment over the poor prospects of any extensive institution of high-speed electrical travel, we must confess that to our thinking the results are satisfactory, not only to the electrician, but to the American railroad engineer. It has long been recognized in this country that a 75-pound rail is too light for modern high-speed railroad travel. Consequently our best roads are equipped with from 90 to 100-pound steel, while on one road at least, the track is laid on broken stone ballast which on many stretches of the line is as much as 2 feet in depth. We venture to say that had the German electrical engineers been able to carry out their trials upon a stretch of the New Haven, New York Central or Pennsylvania Railroad track, there would have been no necessity for them to stop the trials at a speed of something less than 100 miles an hour, on the ground that the track was giving away and the oscillation of the cars had reached the danger point.

And yet it must be admitted that even for American engineers, the Berlin-Zossen trials have drawn attention to what will prove always to be the weakest point in high-speed electric railways. For we must realize at the very outset that the strains on the roadbed will be far greater on electric than on steam railroads, not merely because of the higher speed, but because of the much more severe impact of the concentrated wheel loads on the track, and especially upon the track joints. In steam railroads the heavy loads concentrated on the axles are all spring-supported, whereas in the electric trains a large portion of the weight of the motors is non-spring-supported, and, therefore, its dynamic pounding effect in searching out weak joints in the track and soft spots in the roadbed is enormously intensified. Take, for instance, the electric cars of the magnificent four-track railroad which is to be built from New York city to Port Chester in connection with the New York subway. Here the non-spring-supported part of the motors will weigh between 8 and 9 tons, and at the high speeds of between 70 and 80 miles an hour, which will necessarily be reached at times to maintain the high speed schedule of the road, the smashing effect of this load will be something for which there is absolutely no parallel in any previous steam railroad service in this or any other country. The engineers of this new road, by the way, being fully alive to the new conditions imposed, are building the track with a solidity and strength surpassing even that of the best existing steam roads. Therefore, those of us who look for an early dawn of the era of high-speed electric railroads should feel no discouragement whatever at the failure of the German trials, or rather at the failure of the German track.

ROENTGEN RAY BURNS.

In a very complete article recently published in the Philadelphia Medical Review, Dr. E. A. Codman discusses the burns caused by exposure to Roentgen rays. Nearly two hundred cases are cited, and this large number should silence any doubts as to the reality of the danger. The cause of the Roentgen ray burns is not known, but the primary injury is sustained by the nerves controlling the nutrition of the skin, and there is no reliable evidence to show that injury has ever occurred in deeper tissues without primary interference with the skin. The appearance of the burn is similar to that of sunburn, giving rise in more severe cases to blistering and ulceration. It differs, however, from sunburn in the fact that the body is transparent to Roentgen rays, with a consequent result that the injury extends to the deeper layers of the skin and subcutaneous tissues, even involving tendon-sheaths and joints. A very curious feature of these burns is the fact that while in some instances the injury appeared immediately, in most cases a period of ten days elapsed before the burn was noticed, and in a few cases the burn was not developed until after a delay of months. Some people seem pre-disposed to the malady, while others are not affected in any way by exposure to the rays, and there seems to be no way of predetermining who will be susceptible to these burns.

The injury can be avoided in two ways. A thin grounded sheet of aluminium may be interposed between the patient and the source of the rays. Dr. Codman, however, favors the second method, namely, limiting the time of exposure to a period of safety. This latter preventive is given as a reason for the decreasing number of Roentgen ray burns during the last year, for much shorter exposures are now necessary for the radiographs. The doctor has tabulated a large number of cases in which the time of exposure and distance from the tube are carefully recorded, and comes to the conclusion that an exposure of 5 minutes at a distance of 10 inches from the anti-cathode would be a safe formula. From this we can easily determine the safety period of any distance, remembering, of course, that the power of the rays diminishes as the square of the distance from the anti-cathode. For example, a safe exposure at 20 inches would be 20 minutes, and an exposure of 45 minutes could be made on a subject 30 inches from the ray source.

Another curious phenomenon in connection with these rays is the fact that a repetition of the exposure on the same surface results in accumulative injury. A number of safe exposures oft repeated are seemingly as dangerous as a single long exposure. This would suggest the precaution that, where it is necessary to employ the rays up to the danger limit, an impenetrable metallic plate should shield the entire body, except that portion which is to be radiographed.

GUARDING AGAINST THE SUBMARINE.

For some time past the experimental staff of the British Naval Torpedo School at Portsmouth have been endeavoring to devise some means to frustrate the attack of a submarine upon a battleship. We published in the Scientific American a few weeks ago a description of a contrivance for this purpose, consisting of an outrigger torpedo fired from a pole projecting from the side of a torpedo boat destroyer. A torpedo fired in this manner re-

sulted in sufficient shock to disable a submarine boat within a radius of 30 feet. The drawbacks to the scheme, however, were that the pole was shivered into fragments, at every discharge of the torpedo, while the torpedo boat destroyer itself also sustained a severe shock. Although various other contrivances have been tried, the outrigger torpedo and pole have proved to be the most feasible means for fighting the submarine. The experimental staff has now devised a new and stronger pole, which withstands the shock of the torpedo when detonated, but at the same time allows it to be fired with full effect. A series of trials with the apparatus has been carried out at Portsmouth in connection with a torpedo destroyer, and no ill effects were experienced upon the vessel during the discharge of the torpedo. So satisfied is the Admiralty with the apparatus, that it is to be generally adopted in the British navy.

THE UNITED STATES AND THE METRIC SYSTEM.

Despite the many efforts periodically made to abandon a system long since discarded by every civilized country with the exception of Great Britain, we still cling with Anglo-Saxon stubbornness to the yard, although it hampers us in our trade and complicates our methods of computation.

The most recent agitation in favor of a more rational system takes the form of a bill now before Congress, the purpose of which is to authorize the adoption of the meter by the different departments of the United States government. Most scientists are in favor of the bill. Indignant protests, however, have not been wanting. The American Society of Mechanical Engineers, for example, believe that the metric system "will inconvenience and hinder trade and manufacturing, and require an expenditure of time and money that cannot be expressed in figures, sweeping away as it does the advantages accruing from the numerous established standards now recognized and universally adopted throughout the country."

Keeping that very strong condemnation in mind, it is rather interesting to learn what manufacturers themselves think of the metric system. The Director of the new National Bureau of Standards recently sent out some thirty letters to the leading machine-tool makers in the country, asking for an expression of opinion. The replies received, so far from indicating any opposition, show an overwhelming confidence in the mechanical possibilities of the metric system. Indeed, many of the manufacturers were making machine-tools to metric dimensions.

The American Society of Mechanical Engineers opposes the adoption of the metric system on the ground that the standard inch is better adapted to the calculations of the machine-shop than the millimeter. It is true that by continual bisection of the inch wonderfully accurate measurements are made. And yet the constant tendency in machine-shop practice to use the tenth, hundredth and other decimal parts of an inch, would seem to show a desire to adopt a more scientific system of measurement.

In a half-hearted way the metric system is even now partially used by the government. Foreign mail matter is weighed by grammes, and yet, most reference books and postal guides give the equivalent, for the most part inaccurately, in ounces. The Revised Statutes of the United States, section 3,515, read:

"The weight of the piece of five cents shall be seventy-seven and sixteen-hundredths grains troy." Why this needless circumlocution for five grammes? Surely the business interests of the country can not profit by so complex an expression of weight.

The present movement in favor of the metric system is partially due to the use of metric units in electrical engineering, the standards of which were fixed upon a metric basis by the law of July 12, 1894. The unit of power is the watt, which is equal to 10,000,000 units of power of the centimeter-gramme-second system, and which is practically equivalent to work done at the rate of 1 joule per second. By reason of the enormously rapid development of the applications of electricity, most of us are familiar with the more important electrical units. Especially is this the case with the kilowatt, which is fast taking the place of the old "horse power."

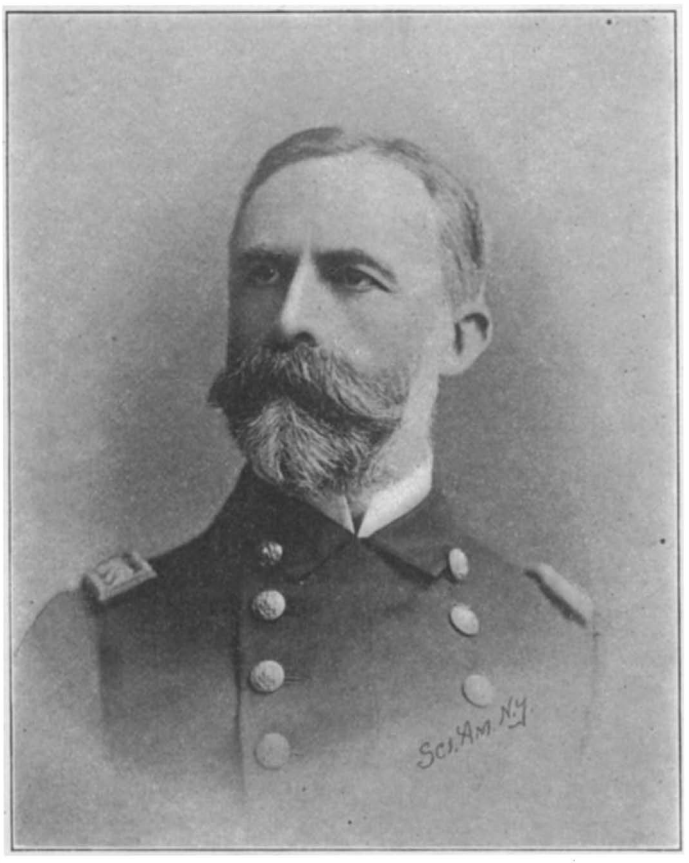
For years the United States Mint has employed the metric system in matters of assay and coinage. Our small silver money weighs 1 gramme per 4 cents. We use the metric weight in everyday life without our knowing it. Who hears of the troy pound nowadays in coinage?

Pharmacists, who of all men should cling tenaciously to the troy system, have long been accustomed to the employment of metrical units. The United States Pharmacopœia, the book most often referred to by the apothecary, is based upon the metric system; so is the Dispensatory, used by physicians. Fine chemicals are now sold chiefly by metric weight; so are glassware and rubber stoppers. Even catalogues in which the prices of goods are given in metric terms are not infrequently met with.

The United States Coast and Geodetic Survey is another department of the government which has long since adopted the metric system. Superintendent of Standard Weights and Measures T. C. Mendenhall, who is one of our foremost authorities on the subject of weighing and measuring, has, with the approval of the Secretary of the Treasury, established the metric system in the Office of Weights and Measures.

In the field of manufactures, the prospect of an early adoption of the metric system is encouraging. In the April, 1900, report of the American Railway Associations Committee, manufacturers were enumerated by whom the metric system is used. The list of products made by metric measurement included watches, injectors, refrigerating apparatus, screw-cutting lathes, scales, drills, gages, measuring implements of all kinds, and draftsmen's tools.

From the standpoint of dollars and cents—the standpoint of the American exporter, who is just now very much the object of public attention—the metric system should certainly commend itself. With the exception of England, every country with which he deals uses the system. No foreign merchant who is accustomed to purchase by kilogrammes and meters, is likely to trouble himself with our complex English units. How well this fact has been recognized is shown by a consideration of some of the products which we export. Ordnance, including both heavy and light, which we have sent to foreign countries, is calibered in millimeters.



The Baldwins build locomotives which are made to travel on one meter gages. Indeed, there is not a first-class shop in the country that is not ready to fill orders for machinery made according to metric measurements. With the increase of our exports, a still wider application of the system may be expected.

When it is considered that the metric system is an international system, that it is simpler than any other (for it is much easier to convert centimeters into meters than it is to convert inches into feet or yards), and that the young men who have graduated from our technical colleges are familiar with its units, there seems to be no very good reason why the change advocated by the measure now before Congress should not become a law. Nothing in this measure prevents any one from using the old system if he so desires. Land can still be sold by the acre in the country and by the square foot in New York city. But one thing at least is certain—if the United States government adopts the system officially, and uses it in its commercial relations with private persons and foreign nations, it will sooner or later be adopted throughout the country.

An item recently appeared in the New York Sun that gives the bibulous man something to think about. It is said that H. Charles Obendaugh, of Binghamton, N. Y., has perfected a process of distillation and compression whereby whiskey can be compressed and carried like pills. Before the possibilites of the whiskey pellet the imagination must stand aghast.

ADMIRAL SAMPSON.

In the death of Admiral William T. Sampson the country has lost one of its most distinguished men, of whom history, we believe, will speak in even yet more positive terms of approbation than do we, whose painful duty it is to record his death and give the customary brief obituary to his honorable, patriotic and most useful life. Nowhere will the worth of the late Admiral be more freely acknowledged than among his brother officers in the United States Navy. It was a fortunate circumstance for himself and for the Navy that the period of its reconstruction found him in the prime of his physical and intellectual powers, for to no one more than to Admiral Sampson is our new Navy more indebted for the universally admitted excellence of its ships and material. His reputation could very well have rested, at least as far as the history of our modern Navy is concerned, with the good work that he did as Chief of the Bureau of Ordnance of the Navy in the construction of the new type of high-power built-up breech-loading rifles and such radical improvements as face-hardened armor plate; for Sampson was an ardent supporter of the Harvey theory, and the early application of Harveyized armor, be it known, placed the United States ships for many years far in advance in defensive qualities of all the vessels of the navies of the world.

When the exigencies of the war with Spain demanded the selection for the command of our Navy of a man with special qualifications, Sampson, although not the senior ranking officer, was chosen, the selection being made because of the technical knowledge, executive ability, calm, judicial sense, and unquestioned courage which he had abundantly displayed in his earlier career. The manner in which Admiral Sampson conducted the naval operations in West Indian waters amply justified the nation's choice, and the technical and military features of the campaign, as ordered by him, have received the practically universal indorsement of naval experts throughout the world. It is true that, for a while, his record was obscured by those miserable miasmas which arise from the swamps of political intrigue and personal hostility; and it is to be feared that the positive cruelties to which he was subjected by his political enemies may have helped to bring about his premature death. Whether that is so or not, it is certain that already the miserable Santiago controversy is being forgotten, and that the heart of the American people is more than ever with the man who, through all the bitterness of that strife, never once opened his lips to make any reference, tacit or otherwise, to the subject.

William T. Sampson was born at Palmyra, N. Y., February 8, 1840. He was born (to his greater honor, be it said) of humble parentage. Whatever of greatness he achieved was won by dint of the sheer force of sterling character. As a lad he divided his time between labors on his father's farm and the Union school, and from the very first he began to draw out ahead of his fellow scholars. He entered the Naval Academy in 1857; three years later he graduated at the top of his class. He had his first taste of the sea in the frigate "Potomac" in 1861; in 1862 he was a lieutenant. Two years later he was detailed to the ironclad "Patapsco," and in the following year, while he was executive officer of that vessel, he was ordered to enter Charleston Harbor and remove or destroy the submarine mines and torpedoes by which the city was protected. In carrying out her work the "Patapsco" was blown up by a submarine mine, and Lieutenant Sampson was thrown clear of the vessel by the force of the explosion, being subsequently rescued from the water with twenty-five of his men. He was attached to the Naval Academy from 1868 to 1871, and in 1874 was made a Commander. From 1879 to 1882 he commanded the "Swatara" on the Asiatic station. Then followed two years at the Naval Observatory, during which time he was a member of the International Prime Meridian Time Conference. He had charge of the torpedo station from 1885 to 1886, and at the same time he was a member of the Board on Fortifications. The period from 1886 to 1890 was spent at the Naval Academy. In 1889 he was promoted to the rank of Captain, and in 1892 was made Inspector of Ordnance, and in 1893 Chief of the Bureau of Ordnance. At the outbreak of the Spanish war Captain Sampson was made Acting Rear-Admiral by the late President McKinley and placed in supreme command, hoisting his flag on the cruiser "New York." He was held to be a great authority on torpedo work, and his lectures at the War College have a world-wide reputation. It was due to his influence that the double-deck turret was introduced on the battleships "Kearsarge" and "Kentucky," and as Chief of the Bureau of Ordnance he was largely instrumental in the construction and equipment of the very fine gun factory at the Washington Navy Yard. His death has left a gap in the ranks of our abler naval men that will not be easily filled.

THE PHOTORAMA.

The subject of panoramic projection has been illustrated and described at various times. This idea seems to have been first realized at the Chicago World's Fair in 1893 by Mr. Chase, but the result was in all probability not encouraging, since the experimental apparatus that he constructed at this time was not used afterward. At the Paris Exposition of 1900 M. Grimoin-Sanson attempted to combine animated projection with panoramic projection. The problem found under these conditions is necessarily more difficult of solution, and it was not solved in a satisfactory manner.

At the present time MM. A. and L. Lumière, who are well known for their remarkable work in all that pertains to photography, have succeeded completely in overcoming all the difficulties that surround this question, while confining themselves, it is true, to unanimated panoramic projection, which alone is sufficiently complicated.

The panorama is not operated as an experiment merely, but forms a regular public exhibition which has been shown for some little time now, in a specially constructed building on the site of the old North Pole skating rink, in the Rue de Clichy.

The first condition to be fulfilled in such a cyclorama is to obtain a continuous circular image that shows no lines of juncture between the several pictures that go to make it up. The inventors have satisfied this condition by employing a continuous circular film joined at its two ends. No effort is made to conceal this one joint, as it forms such a small proportion of the entire surface of the picture that it is scarcely to be noticed. This film is mounted in two metal rings so as to form a cylinder 3.93 inches high by 7.87 inches in diameter (Fig. 2, No. 3); and the principle of operation is that this film being placed in the center of a very much larger cylinder formed by the screen, all that is necessary to project its image on the latter is a strong light within it and a suitable lens without. But as this lens would project only the image of the part of the film covered by it, it would be necessary, in order that it should project the whole image, to revolve it rapidly enough around the film for the retina to retain the impression of the whole image.

The solution of the problem, although apparently simple, is in reality not so at all, first, because the image given by a constantly moving lens is not fixed, and, secondly, because, in order to obtain the proper continuity of the various images, it would be necessary to revolve the lens at a rather high speed, and the light would then be insufficient.

It was necessary in the first place, therefore, to find some way of keeping the image stationary. The Messrs. Lumière, who are not only good theorists in physics and chemistry, but also practical men, have discovered a new optical principle by which they accomplish this result. This consists in placing behind the lens a mirror which inverts the image. The conditions under which this mirror must be placed with respect to the focus of the lens, and the position of the latter as regards the film, depend on considerations based on the formulas relative to lenses that would be too lengthy to go into here. We will simply state that under these conditions the lens can move around the film while giving an image that is perfectly stationary. The necessity of not giving the lens too great a speed of rotation has been fulfilled by mounting twelve lenses in place of a single one, by which means the speed of rotation of the lenses can be twelve times less than would be required with a single lens. The speed is in this manner reduced to three or four revolutions per second, and the brilliancy of the projected pictures is twelves times greater.

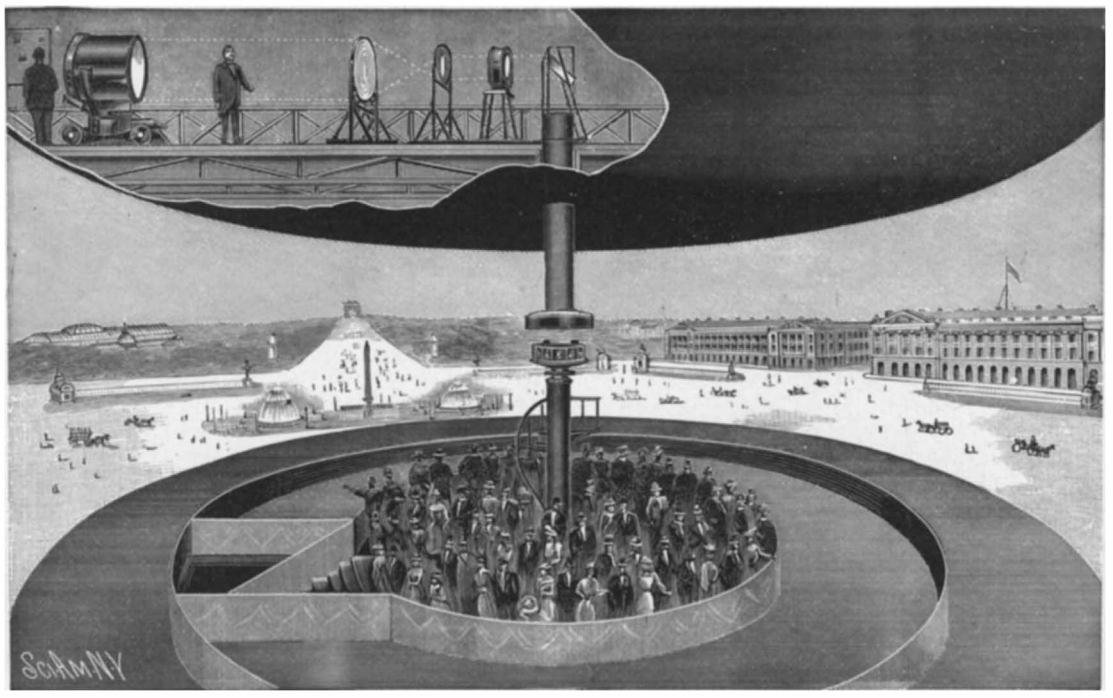


Fig. 3.—INTERIOR OF BUILDING, SHOWING PANORAMIC PICTURES.

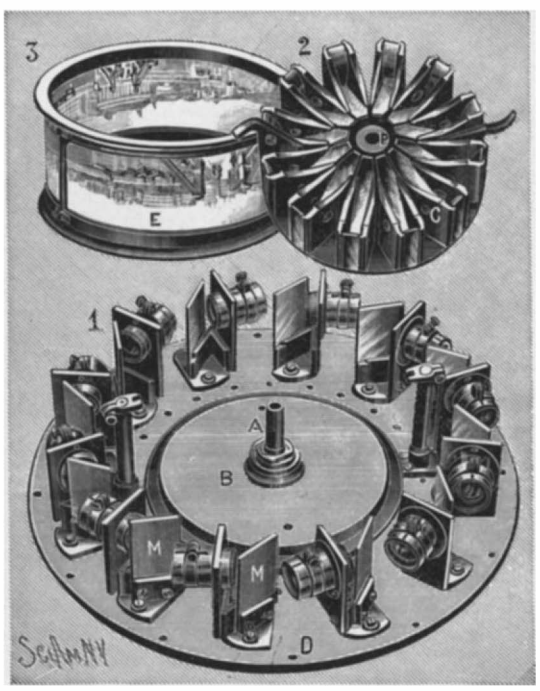


Fig. 2.--DETAILS OF THE PHOTORAMA.

1. Platform carrying lenses and their mirrors. 2. Condensers. 3. Film holder.

But it was not necessary merely to conceive the means of overcoming these difficulties; it was necessary to realize them. Let us examine now, therefore, the construction of the apparatus which is used for projecting the pictures.

The apparatus consists, first, of a circular platform (Fig. 1) on which the film holder, *E*, is mounted, and which forms part of a central vertical axis. This platform is stationary. Below it is a second platform, *D*, movable around the axis, and, within the film, a third platform, *B*, which is also movable. These two movable platforms are connected together by transverse arms passing over the film from the inner one to the tops of posts on the outer, as plainly seen in the illustrations. They turn together, therefore, when a rotary movement is given one of them by a small electric motor.

On the periphery of the large platform, *D* (Fig. 2, No. 1), are mounted the twelve lenses and their respective mirrors, while on the inner platform opposite the lenses (*C*, Fig. 2, No. 2) are placed twelve condensers for illuminating the film. Each of these condensers consists of a rectangular lens of suitable focus placed vertically at the end of a narrow box, the bottom of which consists of a mirror set at an angle of 45 degrees. All the boxes are built in around the central axis, from which they radiate as shown. Under these conditions a powerful bundle of luminous rays directed vertically on the mirrors is dispersed all around the film and lights it equally at every point.

The above description gives, in the main, an idea of the essential parts of the apparatus.

The circular building (Fig. 3), in the center of which the spectators are placed, is 65 feet in diameter, with a screen 26 feet high.

The apparatus we have just described is placed on top of a pillar in the center, and a small electric motor, to which it is suitably connected, gives it the necessary rotary movement. A spiral stairway permits the operator to reach the apparatus easily for the purpose of changing the film. Above the auditorium is a bridge on which is placed a powerful Mangin searchlight with a lens 2½ feet in diameter and a 90 ampere arc lamp of the same type as is used for marine work.

Since the horizontal bundle of parallel rays from the searchlight is too large to fit into the cylinder formed by the film, it is transformed into a cone by means of the first echelon lens, *B* (Fig. 4). This cone is then intercepted by a second lens, *C*, at the proper point to obtain a smaller bundle of parallel rays of the proper diameter, and these rays, after passing through the cooling water tank, *D*, are reflected down through a tube to the condensers by a mirror set at 45 degrees. The water tank through which the rays pass absorbs their heat, so that it does not damage the film.

As the regular Edison circuit is not wired heavily enough to supply a current of 90 amperes' intensity, which is used in the arc light, this had to be produced by a special dynamo driven by an electric motor run by current from the mains.

Notwithstanding the power of this light, the images are not as brilliant as one would expect. This is because each part of the screen reflects some of the

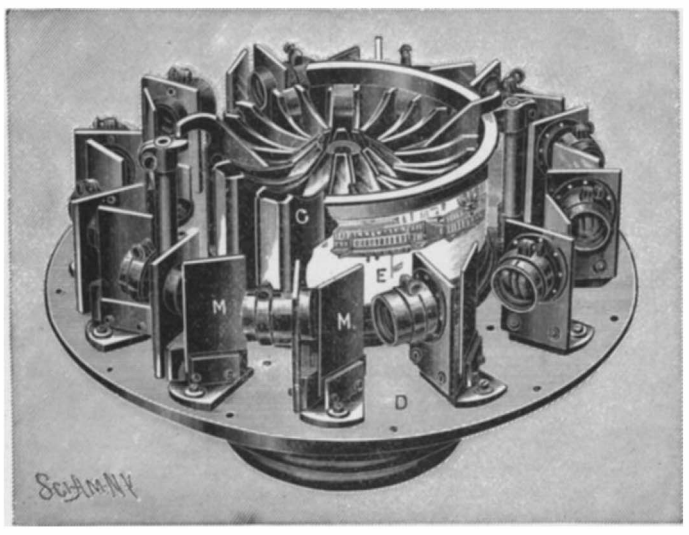


Fig. 1.—THE PHOTORAMA—AN APPARATUS FOR PANORAMIC PICTURES.

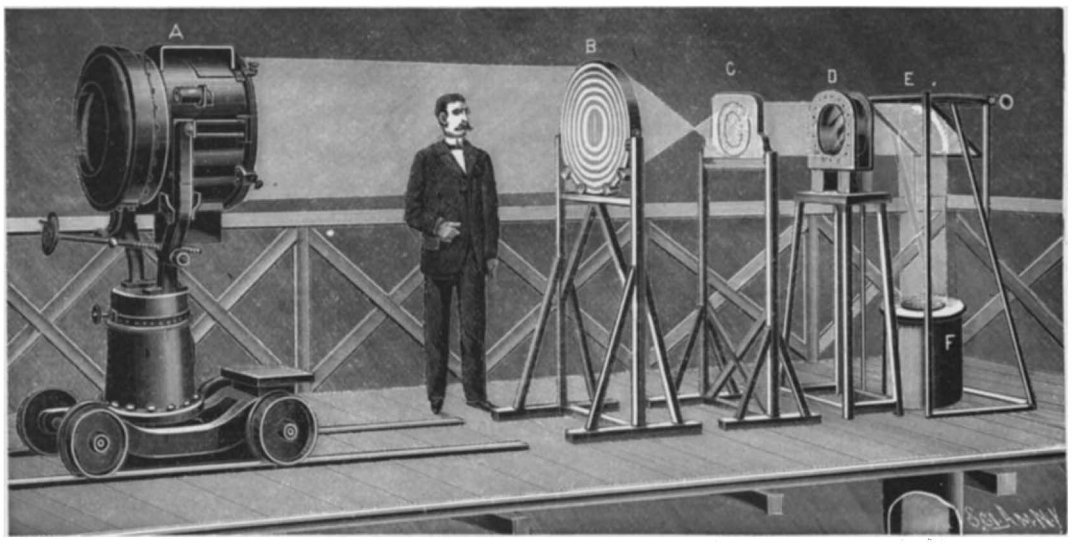


Fig. 4.—LIGHTING APPARATUS.

A. 90-ampere Mangin searchlight. B. Condensing lens. C. Lens forming parallel rays. D. Water tank. E. Mirror F. Pipe leading down to film.

light it receives to the point directly opposite, and this parasitic light takes away the intensity of the projected image. This is shown perfectly if half of the circular film is covered so that no light can pass, when all the illuminated part will at once be seen to gain in intensity. The inventors have tried to remedy this defect by varying the form of the screen, by coating it with different substances, and by various other methods; but up to the present without any great degree of success.

This reflection of the light is not, however, a serious disadvantage, as even with it the image is quite brilliant. We spoke of it merely to show how many unforeseen difficulties were encountered in realizing an idea that is simple only in appearance and that has haunted different inventors for years. — For the above description and the illustrations we are indebted to La Nature.

THE VENICE OF LONG ISLAND.

The intense humidity and generally debilitating effect of the summer months in New York and vicinity render a vacation at the seaside or in the mountains a veritable necessity for those who can afford, and, indeed, for many who can ill afford, the time and expense of making such a change. Those people who are not fortunate enough to own a summer cottage may resort to the less expensive shanty or camping tent; and the sheltered bays and estuaries around New York swarm with people who spend from a couple of weeks to the whole season under canvas, or within the shelter of the cheapest kind of a shanty or hut. One of the most curious and picturesque summer settlements of the kind is a nondescript collection of dwellings, all home-made and pile-supported, which fringes the shore line of a shallow estuary which extends for a mile or more inland from Grassy Bay, a subdivision of Jamaica Bay, Long Island. The estuary is one of several which spread in serpentine fashion through the stretch of tide flats which surrounds the bay. Ordinarily there is in the creek about 4 feet of water, although in the spring tides it is not uncommon to have a variation of 8 or 10 feet in the tide.

"RAMBLERSVILLE" ON JAMAICA BAY.

Ramblersville, as the place has come to be called, has been built chiefly by Germans of the artisan class from East New York, and the materials and style of construction are of the very cheapest. The houses are mainly of one story, and contain usually one. two or three rooms apiece. Each is built on its own little "dock," and has its own landing stage and steps leading down to the water. The outfit consists probably of a bed or two, a table, chairs, and, above all, a flat-bottomed rowboat or sailboat. In the foreground of our illustration is seen a tall pile with slats nailed against it and a diving platform at the top, while in the middle distance is a practical illustration, in the shape of a drawbridge, of the ingenuity which is always the mother of invention; the center span of the bridge is swung by means of ropes extending to a tall mast at one end of the draw.

The inhabitants of Ramblersville are enabled to spend the season at this Newport of Long Island at a minimum of cost in the way of board and lodging. Many of the shacks have been put up for $50 or $75 cost, and the present owners of the land charge only a few dollars for the squatter's right, under which the erection of the shanties is permitted. For food the Ramblersvilleite has only to jump into his flat-bottom boat and spear for eels on the mud flats, or pull out with hook and line the abundant flounders and flukes from the deeper waters; while he can have a clambake at any time for the mere trouble of digging in the mud.

Howard's Dock, of which we present an illustration, represents a more ambitious development of the same style of summer resort, the houses in this case being built on very solid and well-braced pile foundations, and the homes being commodious two-storied cottages, measuring about 18 by 25 feet, and containing four well-finished rooms. The pier extends into Grassy Bay for fully three-quarters of a mile. It has a well-planked surface and is protected by a stout handrail along either edge, so that on the darkest night there is no danger in passing from the houses to the shore. At the outer end of the pier is a large, thoroughly up-to-date hotel, and inshore from the hotel are a dozen or more of the comfortable homes shown in the illustration. The owner and builder of the dock rents the houses for from $150 to $250 for the season, and in front of each is a wide porch, a float, and a hinged gangway. In almost every case the occupants of these homes have their yacht or sailboat moored within convenient reach of the float, and have one or more rowboats tied up, so that at any time, when the breeze is favorable, they can pull off and hoist sail for a cruise to the outside fishing ground. It is claimed by those who make a point, summer by summer, of going down for the season to this unique spot, that for a complete realization of the benefits of seaside life it cannot be beaten, as everything in the way of sea breezes, salt water, bathing, boating, yachting, and fishing is more completely at hand than it could be at any seaside resort of the ordinary type.

HOWARD'S DOCK.

At a meeting recently held in Boston for the purpose of taking action upon the restoration of the "Constitution" to the condition in which she was before the war of 1812, it was unanimously decided that the State of Massachusetts should take up the matter and bear all the expense. The cost of rebuilding the old ship is estimated at $300,000.

An Interesting Sensitive-Flame Experiment.

BY L. DE FOREST.

While conducting experiments with Hertzian waves at the Armour Institute, Chicago, some time since, a rather new and striking sensitive-flame effect was accidentally brought to my notice. At the time I was carrying on the work at night, by the light of a Welsbach gas burner. An ordinary induction coil was used, giving at the time a 1-16 inch spark, and located twenty feet from the gas burner.

The operation of this coil was frequently accompanied by a decided increase in the light in the room; and by altering the adjustment of the air-intake of the Welsbach burner, this increase of light produced by the spark could amount to several candle-power.

For this condition of maximum sensitiveness the mantle was put at considerably less than its maximum brilliancy, portions of it being at but red heat. The flame within, as in the case of the ordinary sensitive-flame, appeared to fan outwardly, at the sound of the spark, extend downward, and play upon the red portions of the mantle, causing these to incandesce. Hence the increase of light. There was a slight lag in the return to normal brilliancy after cessation of the sound.

When the coil was closeted, or placed behind a projecting wall, the effect on the light was naturally diminished; and when the door of the closet was almost but not quite closed, the effect was completely cut off, although the source was in plain view from the lamp.

At first sight this decided light effect from a coil spark might be readily mistaken for a new response to electric oscillations; but as a simple acoustic phenomenon the Welsbach mantle properly illuminated seems to afford an unusually sensitive sound-responsive device. The relative effect of different qualities of sound is very marked; it being, as is the case with the ordinary sensitive-flame for such weak sounds, practically unresponsive to ordinary sound or musical notes, but influenced chiefmost by the sharp crack peculiar to the electric spark. That from a small electric bell held not too far away also showed its effect. As with the ordinary flame this is a pressure phenomenon. The relative proportions of gas and air have all to do with it. An excess of gas is necessary for the effect described, but by increasing the amount of air the reverse effect may be obtained, a diminution of the light by the sound. Between these two effects is a point of neutral regulation, near that of maximum illumination, at which the flame appears entirely deaf to any such sound. I have been able to obtain a falling off in the light of the mantle to one-half or one-third its normal brilliancy (which latter required to be made very low for this extreme sensitiveness, with a small pressure). In this condition the light responded even to the exceedingly weak sound of the primary spark of coil, at the distance named.

When the gas is led to the lamp through a long rubber tube, offering considerable friction to its passage the response is accompanied by a distinct jingling sound in the burner; and sometimes, as a secondary effect of the flame's motion, the whole mantle is seen to rock to one side or the other when the spark is operated.

MANUFACTURE OF STEEL RAILS.—II.

In our first article on the manufacture of steel rails, published in the SCIENTIFIC AMERICAN of April 26, we described the process of smelting the ore, decarbonizing the molten metal in the Bessemer converters, converting it into steel by the introduction of the proper percentage of carbon, and casting it into ingots. The ingots, which weigh 4,500 to 5,200 pounds, are cast in heavy vertical molds, carried on small narrow-gage ingot cars, there being two ingots to the car. After the steel has set the ingots are hauled successively beneath a hydraulic stripping machine, where the molds are drawn clear of the ingots. The latter are then hauled to the pit-heating furnaces, or "soaking pits," in which they are raised to the proper temperature for rolling down into blooms. The "soaking pits" are rectangular, gas-fired furnaces, ranged in a long row from the center of the furnace house. The ingots are charged and withdrawn through the roof of the furnace, the aperture being closed by a horizontally-sliding cast-iron door, lined with firebrick, which is carried upon four wheels, and runs upon a pair of rails, one on each side of the furnace. The doors are operated by means of hydraulic cylinders. The ingots are lifted from the ingot cars and introduced and withdrawn from the pits by means of the electric traveling-crane, shown in our illustration, which is operated by three electric motors. For lifting the ingots there is a 30 horse power motor; for carrying the crane with its ingots along the runway there is a 20 horse power motor; while the derrick-like structure above the crane is traversed across the crane bridge by means of a 7½ horse power motor.

After the ingot has been heated to the proper point for rolling it is lifted from the pit and placed in a small electrically-operated car, in which it is run down to the rolls. As it reaches the table the car is upset by means of a hydraulic plunger, and the hot ingot is thrown over, end-on, upon the feed rollers, by which it is carried through the rolls. After passing through these seven times it is reduced to a section 9¼ by 9¼ inches, and is about 15 feet in length. It is then carried to the bloom shears where it is cut into two or three lengths, according to the length of rails which are to be rolled. For 60-foot rails it is cut into three lengths of 5 feet each; for 90-foot rails into two lengths of 7½ feet. These short lengths are now known technically as "blooms," and the subsequent process consists in rolling and rerolling the bloom until it is in the form of a finished rail of the exact section and weight desired.

The blooms are now conveyed to the Siemens heating furnace in the rail mill. This transfer is made by means of a bloom-carriage which operates between the bloom-shears and the bloom-reheating furnaces into which the blooms are thrust by the charging buggy, shown in our illustrations. These furnaces extend in a straight line through the building for 150 feet, and on each side and parallel to them there are two sets of tracks. On the track adjoining the furnace doors on the charging side is the bloom-carriage, and on the outer track is the bloom-charging buggy. The bloom-carriage consists of two separate trucks, one built up of T-rails on which the blooms are carried, the other being a motor car operated by a Westinghouse 15 horse power dust-proof motor. The bloom-charging buggy is operated by a 15 horse power motor, and it is provided with a long transverse cylinder which operates a pneumatic plunger. When the train of blooms has been brought opposite the furnaces the doors are lifted and the plunger of the charging-buggy moves forward, thrusting one bloom at a time into the furnace. One attendant operates the bloom-carriage and the electric buggy. He stands in the charging-buggy, and by moving one lever shifts the charging-buggy back and forth in front of the heating furnaces, and by means of another lever he operates the controller and moves the bloom-carriage from the shears to the reheating furnace.

On the opposite side of the furnace is another buggy and a pneumatic-electric withdrawing machine, the latter being entirely similar to the charging-buggy above described, except that instead of the plunger-head it carries a pair of tongs which are operated by compressed air. The withdrawing buggy operates along the back of the furnaces, and draws out the blooms upon an electrically-operated table, which carries them direct to the three-high mill, consisting of roughing rolls, intermediate rolls and finishing rolls. In the roughing rolls the bloom is passed backward and forward through five passes, during which it is brought down roughly to the desired section of rail. It is then run to the intermediate or "short" rolls, where it is again given five passes.

At this point the process known as finished rolling differs radically from the method which has invariably been followed of late years in rail rolling, the improvement being known as the Kennedy-Morrison rail-finishing process. Hitherto it has been customary to put the rail through the finishing rolls immediately after its leaving the intermediate rolls, and in early days when the rails were lighter, and there was a smaller mass of metal concentrated in the head, a very excellent quality of rail, with the proper density and toughness, resulted. For several years past, however, or ever since the weight and section of steel rails have been rapidly increasing, there has been a constant complaint from railroad engineers that the wearing qualities of the rails furnished by the mills a dozen or fifteen years ago were much superior to those of the rails which they are now receiving. After the railmakers had increased the quantity of carbon and other constituents to the highest extent consistent with the securing of other desirable qualities besides hardness in the rail, it was decided that further improvement was to be sought rather in mechanical than in chemical treatment. It was argued that the superior quality of the early rails was due to the fact that, being of smaller section, they cooled more rapidly, and the finishing rolling was done at lower temperature, resulting in a better quality of metal, particularly in the head. Hence, with a view to securing similar results in the large 80 to 100-pound rail now rolled, it was decided to introduce between the intermediate and finishing rolls a cooling table, on which the rails would be allowed to cool down to a certain predetermined temperature before being finished.

The necessary changes were made in the mill, and the cooling table was located a few feet to the right of the main run. It is evident that on account of the greater amount of metal and heat contained in the head of the rail, it will cool more slowly than the base and web. To prevent this, each rail is laid on the cooling table on its side, with its head against the flange or base of the rail in front of it, the exchange of temperature between the adjacent metal being such as to cause the whole body of rails on the table, and every part of each rail, to cool off at approximately even temperature. Each rail remains on the cooling table for from three-quarters to one and a half minutes, at the end of which time it is passed through the finishing rolls and brought down to the exact section required by the specifications. The Kennedy-Morrison system, simple as it is, has worked a revolution in the manufacture of steel rails, the quality having been brought fully back to the high standard which prevailed fifteen or twenty years ago. After leaving the finishing rolls, the rails are carried to the hot saws, where they are cut to the exact length, the rails being cut slightly longer than their finished size in order to allow for contraction in cooling. After leaving the hot saws the rails are passed through the cambering rolls, where they receive sufficient camber, varying with the section, to allow the heat still remaining in the rail to deliver a practically straight rail from the hot-beds to the straighteners' beds.

The Current Supplement.

Chief in importance of the articles of the current SUPPLEMENT, No. 1376, is a fully illustrated description of the famous Carrara Marble Quarries. Other articles of interest are those on the mining and working of gold; lamps, burners and heating apparatus exhibited at the Paris alcohol exposition, and physical and chemical properties of alcohol and petroleum. The telpherage system of electric traction, which is just now attracting wide attention, is described in a well-illustrated account. To those of our readers who may not be sufficiently informed as to the distinctions to be drawn between war vessels of various types, an elementary article on the French Navy should be welcome. Charles L. Heisler describes a novel high-duty pumping engine of 10,000,000 gallons per twenty-four hours. The engine is one of his own design. The application of liquid fuel to battleships and the commercial marine is a subject of growing importance; for that reason an abstract of an admirable paper read before the British Institute of Naval Architects is not out of place. The usual Consular Notes are published. It may not be here amiss to call attention to the fact that a new SUPPLEMENT Catalogue, in which the papers published in the SCIENTIFIC AMERICAN SUPPLEMENT are indexed down to January 1, 1902, has been published, and is now ready for gratuitous distribution.

Severo's Airship Trials.

Severo's airship, an illustrated description of which recently appeared in the SCIENTIFIC AMERICAN, was given a trial in Paris on May 4 at the Vaugirard Aerostatic Park.

Severo ran no risks. He fastened his airship—which rejoices in the name "La Paix"—by means of a rope. Severo rose to a height of 130 feet, maneuvered about for a short time and then returned to his shed. The trials seem to have been satisfactory on the whole. The airship is said to have obeyed its propellers and steering gear, and to have maintained perfect equilibrium.

Severo is no inexperienced aeronaut. For over twenty years he has occupied himself with the problem of flying. In 1881 he carried out some dirigible kite experiments in Natal, capital of Rio Grande du Nord. Like Santos-Dumont, Severo is a Brazilian.

Science Notes.

Evidences of a buried village have recently been reported in Lassen County, California, on the line of what was known in 1848 as "Lassen's Cutoff." The discovery was made by a party of surveyors who camped one evening over the spot, and were led by certain indications to make a search for buried ruins. Digging down a short distance, they were rewarded by finding numerous skeletons and a number of peculiarly shaped dishes, cooking utensils, weapons, etc. It is said an expedition will shortly set out to determine the nature and extent of the discoveries.

The First International Congress for Electricity in Medicine and Radiography, which was held in Paris, was a complete success. More than 150 scientists from all countries were assembled. At that time it was voted to hold an international congress at intervals of three years; but in order to avoid clashing with other conventions, it was resolved that the second congress should be held in 1902 at Berne. The Congress will be opened September 1, 1902, at the Physiological Institute, Buehlplatz, Berne, Switzerland. Papers will be read on the present state of electrodiagnosis, surgical electrolysis, radiography and radioscopy of the internal organs, accidents caused by X-rays, and the danger of industrial electric currents. An international exhibition of all electrical instruments of physiological, electrotherapeutic and radiographical interest will be held.

Mr. E. G. Clayton, of London, has been engaged for some time past examining and analyzing the incrustation upon the exterior masonry of the stone gallery of St. Paul's Cathedral. This stone during the two centuries it has been standing has become very weather-worn, and the gray incrustation with which it is covered is as much as ¾ inch in thickness at places. The composition of this substance analysis reveals to be as follows: Water loss at 100 deg., 2.06; water loss at 150 deg., 22.48; carbon (soot), 1.10; calcium sulphate, 59.38; calcium phosphate, 2.22; calcium silicate, 1.63; magnesium silicate, 0.67; iron silicate, 2.40; sand and uncombined silica, 8.06. The substance is stalagmite in character, chiefly composed of calcium sulphate, hydrated together with some silicious matter. It is probable that the rain and the sulphurous and sulphuric fumes exhaled by the surrounding chimneys combined with the rain are responsible for the calcium sulphate deposit.

In a recent number of Science a method of utilizing fluorine from fertilizing plants is described. When natural phosphates are decomposed by sulphuric acid in the manufacture of superphosphate fertilizers, there is much hydrofluoric acid set free as such or as fluoride of silicon. This is especially the case when apatite is used; indeed, this fact detracts very materially from the value of the immense apatite deposits of Canada. In Germany manufacturers are compelled by law to prevent the escape of these deleterious gases into the atmosphere, and efforts are being made to utilize the waste product. By leading the gases through water, fluosilicic acid is formed, and from this solution sodium fluosilicate or magnesium and aluminium fluosilicates may be readily prepared. The last two have some use in hardening calcareous stone. More recently it has been discovered that fluosilicic acid has strong antiseptic properties, and that as a preservative of manure it surpasses plaster, kainite, or superphosphate of lime. The denitrifying action of bacteria is checked, preventing the loss of nitrogen. The greatest difficulty in the way of its adoption for this purpose is its preparation in suitable form. The aqueous acid in bottles would hardly be acceptable to the farmer, and no satisfactory absorbent of the acid has been found. A patent for a new manure preservative has recently been taken out, in which the fluosilicic acid is incorporated with clay, with the bases of which it for the most part combines. With this powder goes another consisting of a porous substance saturated with sulphuric acid. A small quantity of each powder is scattered over the manure pile, and by the action of the sulphuric acid on the fluosilicates fluosilicic acid is generated, which acts as an antiseptic.

Martinique's Disaster.

Terrible news comes from Martinique. The town of St. Pierre has been completely destroyed by fire, with a loss of life that is appalling. Not only is the town wiped out, but thousands of its inhabitants have perished. The cause of the disaster was the eruption of the volcano Mont Pélée. On the morning of May 9, the crater began to belch forth molten rocks and ashes. Within a radius of four miles, in which district the town of St. Pierre is included, terrible destruction was wrought. The Commander of the French cruiser "Suchet" in a telegram to the French Minister of Marine states that the entire population of about 25,000 persons is thought to have perished. The "Suchet" brought back about thirty survivors. All the shipping in the harbor was destroyed by fire. Further news will be awaited with anxiety.

Engineering Notes.

A petrol motor has been fitted to one of the large boats at Lowestoft, England, employed in the North Sea herring fishing industry. The engine is of 24 nominal horse power, having three cylinders of 6½ inch bore and stroke, and a speed of 300 revolutions per minute. Economy of storage space is a marked feature of this type of motor, which is stowed in the cabin under the crew's table. Propelling the boat is not intended to be the sole use of the motor. It is also employed as a donkey-engine, to heave anchor, to hoist sails, and to work the pumps. The extremely small weight, both of the motor and the fuel to be carried, and the necessity for so few alterations in construction, make the adaptation of petrol motors to existing boats of this class a comparatively simple matter.

Sir William Arrol & Co., the famous bridge building firm of the Dalmarnock Iron Works, Glasgow, have secured the contract for the construction of the huge railway viaduct to be erected over the River Barrow, in the south of Ireland, in the face of strong American and European competition. The erection of this viaduct is a part of the scheme being undertaken by the Fishguard & Rosslare Railway & Harbors Company, for developing the inter-communication between these ports and Milford Haven in the south of Wales. The viaduct is to be 1,980 feet in length, consisting of thirteen fixed spans each of 140 feet, and two opening spans each of 80 feet, through which vessels will be able to pass at high tide. Owing to the peculiar nature of the soil of the bed of the river huge cast iron caissons will be sunk to a considerable depth —to 100 feet from the under side of the superstructure of the bridge to the bottom in some instances. The bridge is to be built of steel throughout. This company also recently secured the contract for the large bridge carrying the Caledonian Railway of Scotland across the Clyde from the central station at Glasgow.

Quartz bowlders and pebbles found in placer gravels are frequently reported to carry no quartz gold, according to The Mining and Scientific Press. The condition is not universal, for placers are known in which the quartz bowlders and pebbles do contain gold. The barren character of such float quartz is far the more common, however, and has been the foundation of many theories of formation of the gold found in the placers which excluded the idea of its coming originally from the quartz. The explanation of the seeming contradiction is simple. The gold in quartz is originally associated with pyrite and other sulphides. Surface percolating waters oxidize these sulphides and largely remove them, before the quartz, still containing the gold, by erosion of its overburden is itself in turn eroded and becomes placer. The quartz breaks up on its lines of least resistance, which are the lines where sulphides have been removed. The larger part of its original gold content is thus freed and the separated quartz fragments are barren. In addition to the structural weakness of the quartz containing gold, its higher specific gravity constantly increasing as the fragment becomes smaller by abrasion, by retarding its downstream movement relative to quartz containing no gold, keeps it for a longer period of time under abrading influences. There are as well many quartz ledges that are barren of gold, and those ledges that do contain gold have barren portions. Such barren quartz, called "bull quartz" by the miners, is more resistant to disintegration than the gold-bearing quartz. It may thus happen that the quartz found in the gravels with the gold is not the quartz from which the gold was derived.

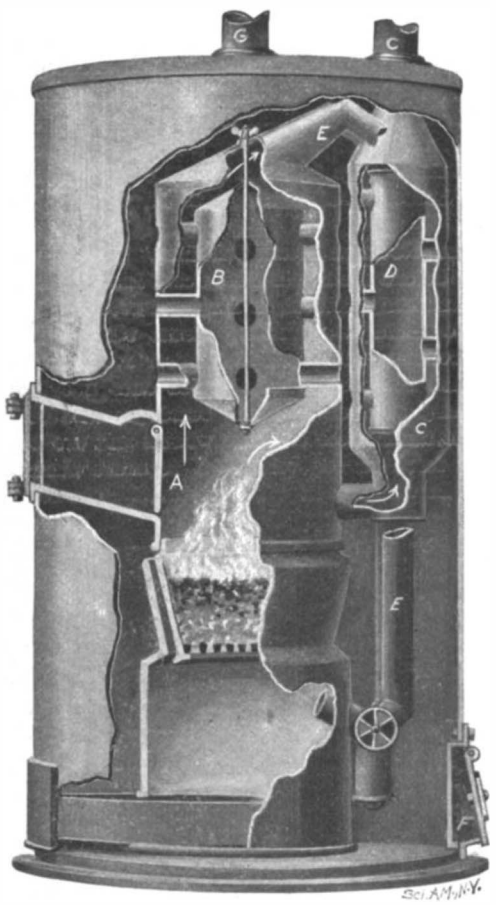
Death of President Morton.

President Henry Morton of Stevens Institute of Technology died on the evening of May 9, at the age of sixty-six. A scientist of world-wide reputation, Professor Morton began his scientific career as an instructor of chemistry and physics at the Protestant Episcopal Academy in Philadelphia. He became a founder of the Philadelphia Dental College in 1863, and was first to hold its chair of chemistry. As an archæologist, Professor Morton also distinguished himself. In 1859, he published a translation of the text of the Rosetta stone. While Resident Secretary of Franklin Institute and editor of the Institute's "Journal," he organized an expedition to photograph the total eclipse of the sun in Iowa. When Stevens Institute was founded in accordance with the will of Edwin A. Stevens, Professor Morton was made President. He held that position down to the time of his death. To Professor Morton's earnest efforts the success of Stevens Institute and the very high place which it has assumed in the technological schools of this country is largely, if not entirely due. The interest which he took in the Institute is sufficiently manifested by his liberal endowments. He gave the Institute a mechanical laboratory fitted with steam engines and tools. Out of his own purse he furnished apparatus for the study of applied electricity and guaranteed the salary of a professor of electricity. When a chair of engineering practice was established in 1888, Professor Morton endowed it with $10,000, following this gift four years later with another of $20,000. In 1897 Dr. Morton received the degree of Doctor of Laws from Princeton.

A NEW HEATER.

A heater of peculiar construction has recently been patented by two Nebraskan inventors. It belongs to the class in which hot air is used as a heating medium, and aims to receive a large amount of air and to provide a large area of radiating surface, thus supplying great heat with an economical use of fuel.

In our illustration the heater is partly broken away to show the peculiar arrangement of outer and inner drums which are designed to superheat the air. Supported on the fire-pot is a drum, *A*, closed at the top, excepting that it has two flues or pipes, *E*, leading downward and admitting the air again below the grate. Fresh air enters the outer casing through the damper, *F*, and a valve on the pipes, *E*, controls the supply of fresh air to the fire. The projection seen below this valve is provided with a removable bottom, so that soot may be readily cleaned from the pipe. Supported within the drum, *A*, is a smaller, interior drum, *B*, which is entirely closed to communication with the gases from the fire, but communicates with the space between the drum, *A*, and the outer casing through a series of tubes. Similarly, a cylinder, *B*, is arranged within the



A PECULIARLY-CONSTRUCTED HEATER.

enlarged portion of the take-up or smokepipe, *C*, which communicates at its lower end with the drum, *A*. If desired, a pipe, *G*, may lead from the heater to an upper room for the purpose of heating the same.

The following operation is claimed for the heater: Cold air entering the damper, *F*, at the bottom of the outer casing will pass through the air valve and discharge into the firebox. This air will circulate through the drum, *A*, with a portion of the smoke, while a portion of the air with a certain amount of smoke will pass through the smokepipe, *C*. Warm air surrounding the drum, *A*, will pass through the tubes into the cylinder, *B*, and warm air will also pass through the tubes into the cylinder, *D*. The air and smoke passing through the drum, *A*, will move downward through the pipe, *E*, and again discharge into the lower portion of the firepot, and during this discharge it will have mixed with it a new supply of pure air or oxygen, thus causing a part of otherwise wasted combustibles to be used. By this great circulation of air the lower portion of the heater will become thoroughly heated, and thus heat the lower stratum of air in a room which is usually cool. The inventors of this heater are W. M. Thomas and L. Van Scoyoc, of Louisville, Neb.

Yale Honors Lord Kelvin.

On May 5 Lord Kelvin received at Yale University the honorary degree of LL.D. at a notable ceremony in which the entire university took part. For the first time in over one hundred years a special assembly has been held at Yale for the conferring of an honorary degree. Lord Kelvin was ushered in the Battell Chapel to the strains of a large symphony orchestra.

In conferring the degree, President Hadley spoke thus:

"William Thomson, Baron Kelvin—To some of the men of science it is given to render practical service by their discoveries; to others it is given to use those discoveries as a means to the profounder understanding of the laws of the universe. Yours has been the rare honor of combining both these results in the work of a single life. You have joined the remotest regions of human activity by your investigations of the submarine telegraph; you have joined the different realms of human thought by your contributions to physical theory. In recognition of this long and glorious service, wherein each achievement which seemed to the world a culmination of your labors was to you only an incentive to labors more arduous, and the stepping stone toward achievements yet higher, we confer upon you the degree of doctor of laws, and admit you to all its rights and privileges."

Electrical Notes.

Madison, Wis., is a university town, and like most university towns it has a campus upon which grow huge trees. In these trees squirrels have made their habitation, to the great delight of the students and townspeople. For a long time the telephone service of the town has been bad. No one knew why. Finally a curious official discovered that the squirrels had nibbled off the insulation of the telephone cables, cut into the wires, and wrought havoc in many other ways. Rather than exterminate the squirrels, the telephone company determined to keep the force of linemen busy repairing the ravages. But the squirrels have eaten away the insulation faster than the linemen could supply it. A crusade against the squirrels will probably be instituted, despite the protest of the university faculty.

A long critical article on the position of wireless telegraphy appeared recently in the Kölnische Zeitung, which, as is well known, is one of the most influential papers in Germany. The agreement between the Marconi Company and Lloyd's is strongly criticised, and our contemporary asks if the Marconi Company and Lloyd's are really so naïve as to think that the States in whose territory the signaling stations would exist would not oppose this "monopoly-greed." Our contemporary further asserts that the communication from the German government on an international agreement on the subject of wireless telegraphy was not due to the refusal of the Nantucket lightship to communicate with the "Deutschland," but that the subject had been mooted some time previously. The article also compares the Marconi, the Slaby-Arco and the Braun systems from a technical point of view, and claims that the two former have both adopted, in their system of transmitting, a method of which Braun is the original inventor and patentee. It suggests a combination of interests between the owners of the Braun and Slaby patents, who should fight the Marconi Company on the patent question. It will be remembered that the Slaby-Arco patents are owned by the Allgemeine Elektricitäts Gesellschaft, and that the Braun patents are the property of Messrs. Siemens & Halske.

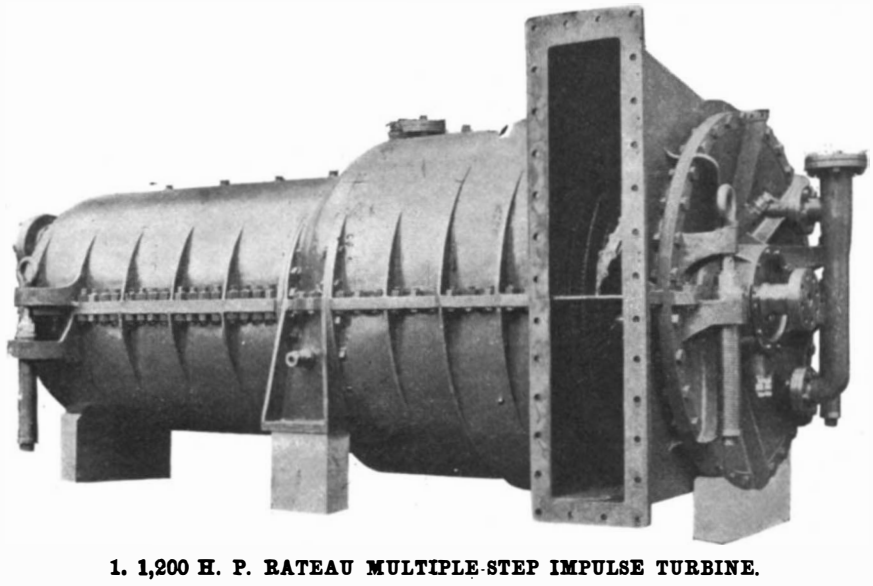
It is well known that high-voltage currents have been in use for years in the United States for long distance transmission of energy. Some of the plants, where the climate is very favorable, have adopted voltages up to 40,000 and even 50,000 volts. On the Continent, where water power in the immediate vicinity of industrial centers is becoming more and more scarce, long distance power transmission with high voltage is being frequently resorted to, as the following will show: A 23-mile transmission at 20,000 volts has been constructed to supply Como with energy. In the vicinity of Zaragoza, in Spain, two plants, of 4,000 horse power and 6,000 horse power respectively, are being installed. The power obtained will be transmitted at 30,000 volts over distances of 28 and 50 miles. The Feurs and Morge installation near Grenoble, in France, is a 7,000 horse power plant, supplying current at 26,000 volts to a number of towns and villages, such as Voiron, Moirans, etc., the distance covered being 32 miles. This plant has been completed and is now working. The Reznau plant near Waldshut provides 10,000 horse power, and the current is sent over distances up to 37.5 miles at a voltage of 25,000. Lastly, an order has recently been placed for the machinery of a 13,000 horse power plant to be erected on the Cellina River in Northern Italy, the energy being supplied, at a tension of 36,000 volts, to the towns of Venice, Udine, Pordenone, etc. Current in this installation is transmitted over distances up to 56 miles. In all the above plants the current is three-phase, and is generated at a comparatively low tension of a few thousand volts, and raised to the transmission voltage by means of stationary transformers.

A company is to be formed in England for the purpose of utilizing Mr. Edison's patent for extracting iron ore and profitably working the deposits on the west coast of Norway. The company is said to be capitalized at $10,000,000.

THE INTRODUCTION OF THE STEAM TURBINE FOR LIGHT AND POWER WORK.

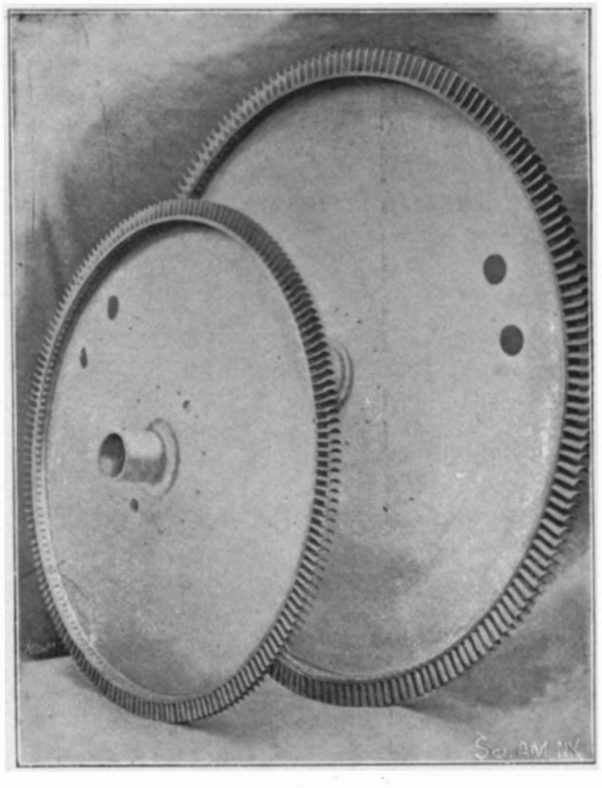
BY FRANK C. PERKINS.

The use of the steam turbine has developed wonderfully of late, and it would not be surprising if the practice of using high-power slow-speed steam engines directly connected to heavy flywheel alternators should be entirely reversed in the near future, these slow-speed units being replaced by the high-speed steam turbine and direct-connected alternators of comparatively small size. The small space which the steam turbine and alternator occupy for a given large output will hasten their introduction, especially as the economy of operation may be fully as high as the best compound or triple-expansion slow-speed engines of the present time. The low cost of both steam turbine and high-speed alternating current generator will also be a factor which is not to be disregarded. The accompanying illustrations, Figs. 1, 2, 3 and diagram, Fig. 7, show a type of steam turbine being introduced by the Maschinenfabrik Oerlikon in Switzerland. This turbine was designed and constructed by Prof. A. Rateau, in connection with Sautter, Harle & Co., of Paris, and consists of a number of Laval or Pelton wheels arranged in series on a shaft, each of which revolves in a separate chamber, the whole forming a multiple-step impulse turbine, the steam being conveyed to the vanes on the wheels by distributing nozzles which are fixed, and the expansion taking place in the latter. There are two sizes of wheels in the turbine; one system of fifteen smaller wheels and another of ten wheels of larger diameter. The turbines give in effective work from 65 to 70 per cent of the thermodynamic capacity. At an admission pressure of 13 atmospheres and 0.1 atmosphere of vacuum, the theoretical consumption per horse power hour is given at 3.7 kilogrammes; while the actual consumption is from 5.7 to 5.3 kilogrammes per horse power hour; and when the turbine is direct-connected to the electrical generator, 8.1 to 7.5 kilogrammes is the consumption per kilowatt per hour. Reckoning an economy of 10 per cent at 60 degrees superheating, the consumption is 7.3 to 6.8 kilogrammes per kilowatt hour. A number of Rateau steam turbines have been constructed of 1,200 horse power whose weights are 3,500 kilogrammes each, or about 3 kilogrammes per effective horse power. Another machine of 1,800 horse power is expected to have a steam consumption of about 12 pounds per brake horse power per hour; while the turbine of this type of 2,500 horse power is not expected to run over 1.4 kilogrammes per effective horse power in total weight, without the generator.

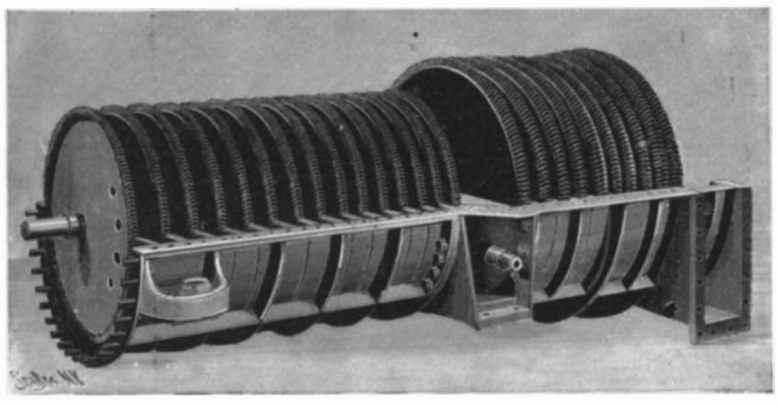


1. 1,200 H. P. RATEAU MULTIPLE-STEP IMPULSE TURBINE.

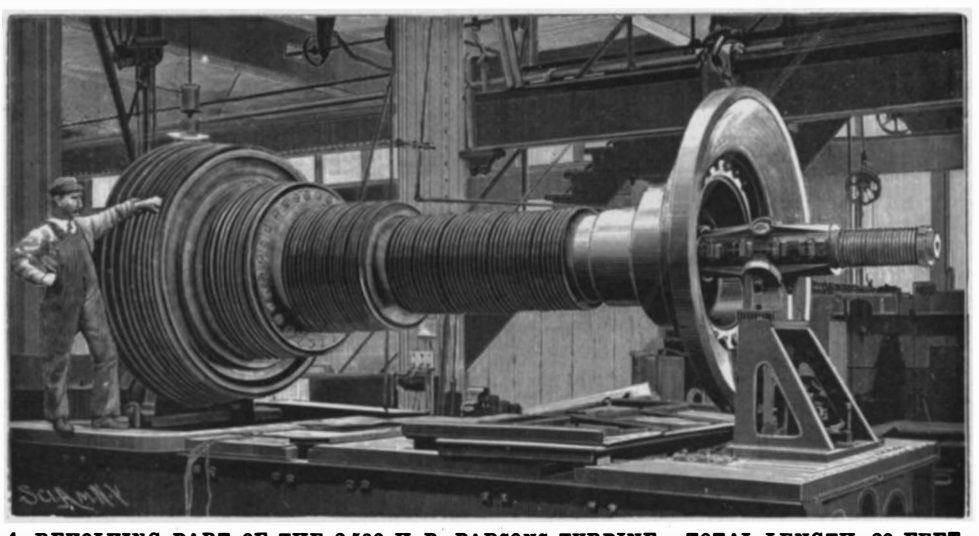
In "Some Notes on Steam Turbines," by F. J. Warburton, read before the North-East Coast Institution of Engineers and Shipbuilders in England recently, he mentions two multiple-expansion steam turbines; one a single-direction motor and the other reversible. The former has fourteen wheels keyed onto a cylindrical shaft, slung between resilient bearings; and cells are cut in the inner faces of these wheels and the walls of the cells form curved vanes. A separate chamber is provided in which each wheel revolves. The steam enters at the center chamber at 75 pounds pressure absolute, then passing to the vanes of the first wheel through four diagonal nozzles piercing the partition. The direction of the jet is reversed as nearly as possible by the curved vanes, the steam passing over the outer periphery. Somewhat larger nozzles are used to guide the steam onto the wheel in the next chamber, and it continues through the various chambers to the last or seventh wheel, when it is again carried back through an ample passage to a center chamber not provided with a wheel, and then the steam expands through the various steps of chambers and wheels to the exhaust, the nozzle areas being so proportioned that each wheel does its share of work. Floating packing rings are used for isolation of chambers and end packing, being held against the surfaces by the



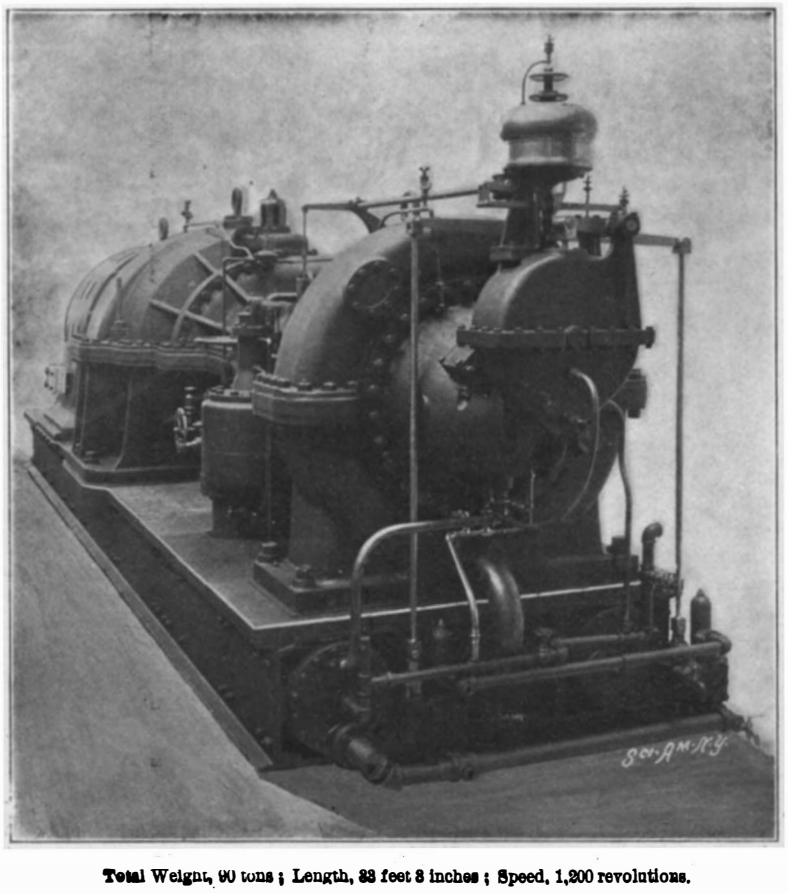
2. LARGE AND SMALL DISKS OF THE 1,200 H. P. RATEAU TURBINE.



3. ROTATING PART OF 1,200 H. P. MULTIPLE-STEP RATEAU TURBINE.

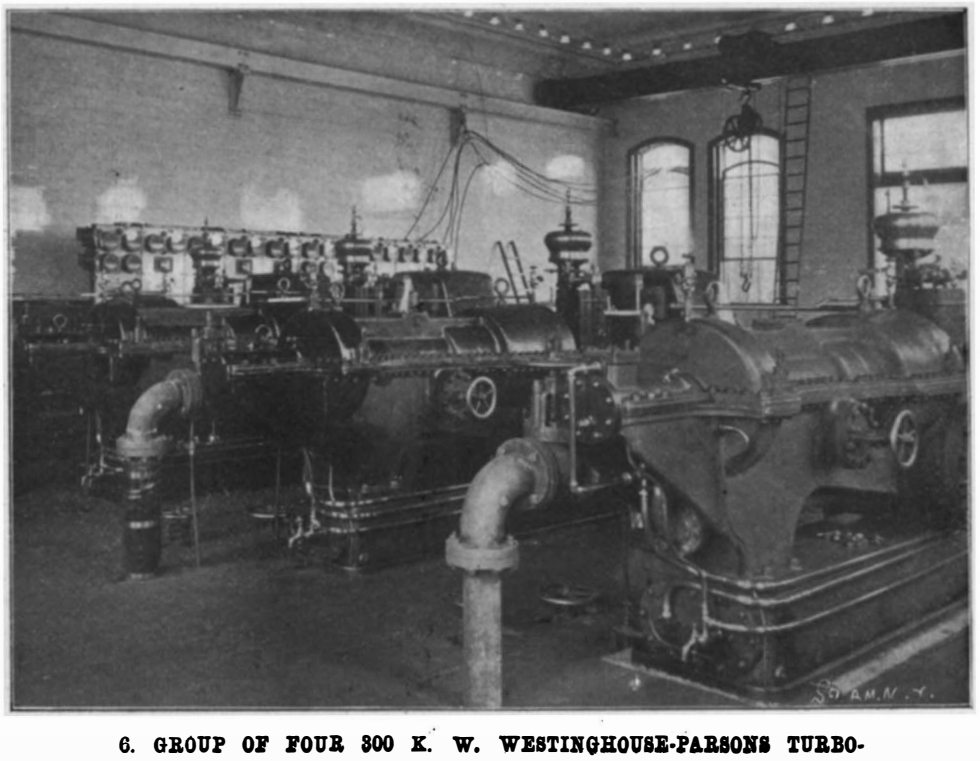


4. REVOLVING PART OF THE 2,500 H. P. PARSONS TURBINE. TOTAL LENGTH, 20 FEET. WEIGHT, 14 TONS.



Total Weight, 90 tons; Length, 33 feet 3 inches; Speed, 1,200 revolutions.

5. 1,500 K. W. WESTINGHOUSE-PARSONS TURBINE AND ALTERNATOR.



6. GROUP OF FOUR 300 K. W. WESTINGHOUSE-PARSONS TURBO-ALTERNATORS.

steam pressure. When running, it was found that no internal lubrication was necessary, with no wear on the rings and shaft, the rings not revolving with the shaft, but remaining stationary and floating on a thin layer of steam between the shaft and ring. With superheat this turbine was very economical in steam consumption, running well at a speed of 5,000 revolutions per minute.

The reversible turbine mentioned has two oppositely inclined sets of nozzles pierced in each chamber wall, the "go-ahead" sets playing on the most efficient side of the wheel vanes. This turbine was reversed from 4,000 revolutions per minute ahead to 4,000 revolutions in the opposite direction in five seconds, giving 75 per cent power backward with the same steam pressure.

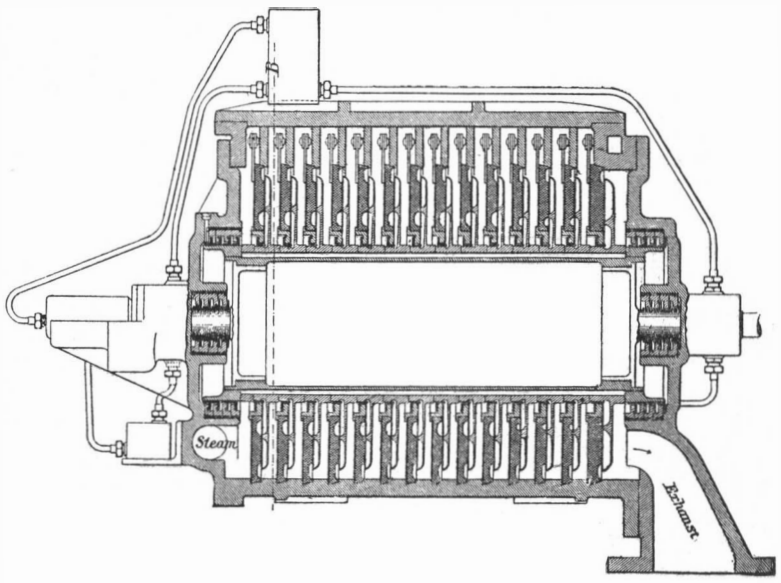
If equal reversing power is desired, the astern nozzles may have 25 per cent more area. A very thin circular valve is placed in front of each partition, the ports corresponding to the entrances of the nozzles, and a lever and shaft rotate these valves through a small angle, one way or the other, to produce forward or backward motion.

The simplest form of impulse steam turbine is the De Laval; but the disk turbines in this type must revolve at enormously high speeds, which in the case of a one-foot turbine reach about 15,000 revolutions per minute, with a pressure of about 75 pounds. In this form, which greatly resembles a Pelton waterwheel, the fixed nozzles guide the jets of steam onto the vanes or buckets on the outer rim of the rotating wheel.

A 100 horse power Laval steam turbine was installed some time ago in some German paper mills, and worked with such satisfaction that a 300 horse power turbine was installed later, a test of which was mentioned by W. Jacobson in the Zeitschrift Vereines Deutsch. Ingr. The dynamo was constructed by Ganz & Co. and the turbine by the Actiebolaget de Lavals Angturbin, of Stockholm. The speed of the turbine was 10,500 revolutions per minute, and the generator speed was 750 revolutions per minute, gearwheels being used for the reduction of speed; and an electric motor for operating an independent air pump. A Kausch superheater was employed and a Durr boiler; and with a steam pressure of 132 pounds and a vacuum of 26 inches, the steam consumption was about 18 pounds per horse power hour, the power developed being 300 horse power. The consumption was reduced to about 17 pounds per horse power hour with the steam at 572 deg. F. The length of the test was a trifle over five hours, and the mean steam temperature at the superheater was 415.6 deg., while the mean steam pressure in the boiler was 154.5 pounds. The temperature of the steam due to 154.5 pounds pressure was 364.8 deg. F., while the mean vacuum was 27 inches of mercury. The brake horse power was 342.1 with a mean reduced speed of 754.66 revolutions per minute. The water per brake horse power per hour was 15.67 pounds with an output of 337.6 brake horse power. In this test the steam for driving the feed pump, as well as the power to generate the current which was used to run the air pump electric motor, was taken from another independent boiler.

In a paper on Steam Turbines before the Engineers' Society of Western Pennsylvania, some time ago, Mr. F. Hodgkinson mentions a test made in France, where a Laval turbine working at 307.8 horse power with a speed of 772 revolutions per minute and a steam pressure of 192 pounds gave 13.92 pounds of steam per horse power hour. The superheat at this consumption was 69 deg. F. He also cites a Parsons turbo-alternator of 1,200 kilowatts capacity, which, when running under a pressure of 130 pounds and a superheat of 18 deg. F., produced an electrical horse power with a steam consumption of 14.025 pounds, which is equivalent to 11.9 pounds per indicated horse power hour, and in this case the turbine was driving its own air pump.

It is well known that geared motors are very undesirable, and are avoided wherever possible, and the multiple-step steam turbine of the Parsons type was devised to give a reduced speed of rotation suitable for the driving of machinery direct without the gears necessary with the Laval high-speed types. The first parallel-flow turbines constructed by Parsons consisted of a collection of zig-zag nozzles, the walls being formed of projecting rings of blades and intermeshing. One set was fixed on the periphery of a revolving cylinder, and the other set on the inner surface of the stationary hollow cylinder. The shape of the steam passages has been changed in the latest types of these turbines to smooth sinuous curves, and



7. EXPERIMENTAL, REVERSIBLE, MULTIPLE-STEP, STEAM TURBINE OF RATEAU.

the steam does not have to pass any sharp corners or turns. The highest economy of steaming of the modern Parsons steam turbines compares most favorably with the best reciprocating engines of high power and economy of the compound and triple-expansion types. The clearance and the workmanship in the construction of these turbines must be of the very finest, and the passage of steam from one end to the other acts as in a continuous nozzle, the expansion taking place between the moving and the fixed blades.

There are four of the Westinghouse-Parsons steam turbines in operation in the electrical power house of the Westinghouse Air Brake Company, each driving a 300-kilowatt alternator. The direct-current exciters are continuous-current, four-pole dynamos, driven by Westinghouse vertical engines. The speed of the turbo-alternators is 3,600 revolutions per minute, the alternators being constructed as bipolar machines. With a boiler pressure of 125 pounds per square inch and a vacuum of 26 inches, the full load consumption of these machines is about 16.4 pounds per electrical horse power hour, rising to about 22 pounds at a quarter load.

Prof. R. H. Thurston is quoted as stating that there is a considerable gain in both efficiency and capacity of a steam turbine by the use of superheated steam, but that the gain is greatly in excess of what would be expected from the increase of thermodynamic efficiency due to the higher range of temperature. The experiments made at the Sibley College at Cornell University on a 10 horse power Laval turbine show a gain of one per cent in efficiency for each three degs. superheat, while the increase would not be over one-tenth of this. The gain in efficiency is proportional to the amount of superheat; in the above case the capacity was doubled by the use of a superheat of 37 deg. F. The additional gain, Prof. Thurston says, seems to be due to the elimination of the loss by friction caused by moisture in the steam as it passes through the turbine.

In the Curtis steam turbine a few wheels of large diameter are used. The Curtis turbine is constructed with provision for changing the nozzle areas by opening or closing the tapered walls according to the load. In this way it is said to correct the expansion ratios for various loads and steam pressures. The fixed steam nozzles play only on part of the periphery of disks, in some cases only two nozzles being employed on the first disk.

The Westinghouse-Parsons steam turbo-alternator, which is now in operation at the Hartford Electric Light Company's plant, consists of a 2,500 horse power steam turbine direct-connected on the same base to a Westinghouse 1,500-kilowatt, sixty-cycle, two-phase alternator. The speed of this unit is 1,200 revolutions per minute, and the polyphase current delivered by the generator has a potential of 2,400 volts. The size of the generator is comparatively small for an output of 1,500 kilowatts, on account of the high speed of the turbine, and at a frequency of 60 periods per second the number of poles required is only six. The revolving part of the turbine is nearly 20 feet long and about 12 feet between bearings, while it weighs about 14 tons. The total unit, including generator and turbine, is nearly 34 feet long and about one-fourth as wide; while the total weight is about 90 tons. A worm gear is used to drive the governor and oil pump. The turbine is automatic and requires little attention, while the repairs and renewals of this class of machinery are very low, on account of the few working parts; and because of the absence of rubbing surfaces, high superheated steam and condensers can be employed to the best advantage, as no internal lubrication is necessary.

Unquestionably the day of steam turbines has come, particularly of large sizes, not alone on account of the wonderful economy of steam consumption; but also because of the advantages of economy of space, absence of oil from the condensed steam, and the excellent conditions for the use of superheated steam, as well as almost an entire absence of vibration. The sizes mentioned above have in each case been for increased output, those at Hartford, Conn., having a capacity of 2,500 horse power.

Fig. 1.—A ROCK PILLAR AT ACOMA, NEW MEXICO.

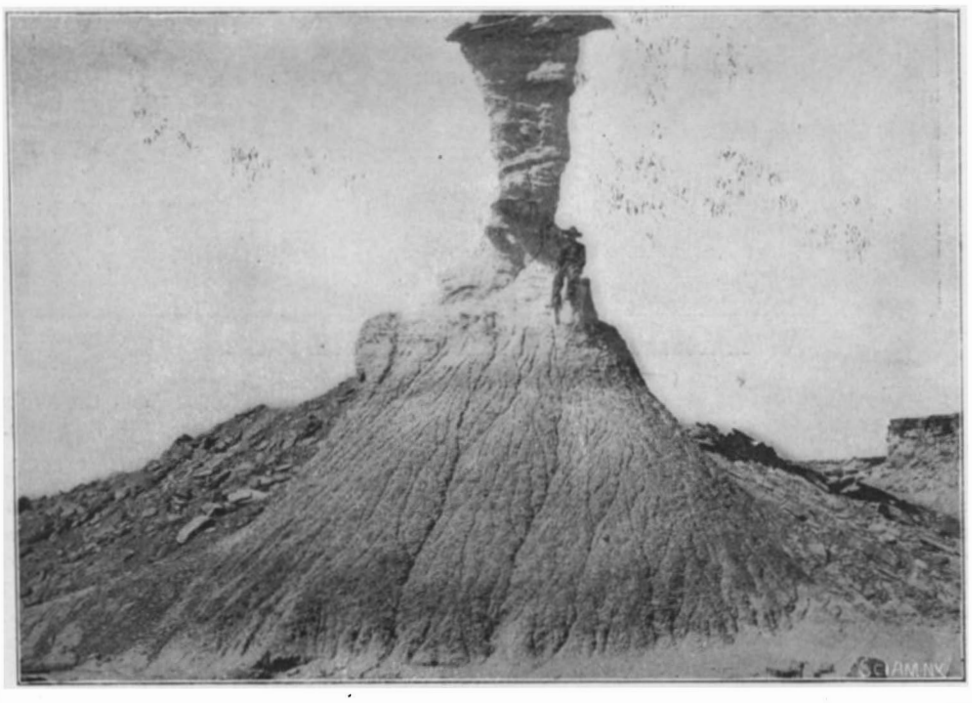


Fig. 2.—A COLUMN OF SHALE, SHOWING ERODED BASE.

BUTTES AND THEIR FORMATION.

BY CHARLES FREDERICK HOLDER.

It is demonstrated that if the dry land of the globe, the continents and islands, could be leveled or shoveled into the ocean the latter would cover the entire globe, so vast and deep is the watery envelope. The continents, then, and their inhabitants, might be considered simple accidents, as had the globe remained quiescent and upheavals of the crust not occurred, the globe would have been a vast sea. Happily for the human race the reverse held, and man has made his home upon what are virtually the tops of mountains or long elevated

mountain ranges ten miles in height measuring from the top of the highest mountain to the deepest abyss of the ocean. Many changes have occurred in the past millions of years since the dry land appeared, and doubtless many of the mountains were much higher; but nature is ever carrying on a fierce warfare, and slowly and imperceptibly the heights are leveled, the mountain peaks denuded, and the dry land washed down the great river courses into the sea; and theoretically, given sufficient time, assuming that no elevation occurs, the entire earth may disappear.

This wear and tear of nature is accomplished in many ways, and is productive of interesting results. Frost, snow, wind and rain are the principal erosive agents which are chiseling, cutting, grinding and wearing away the surface of the earth. The elements are all levelers, and the tendency is to reduce the mighty monuments of nature and level them in the dust. In the accomplishment of this, many remarkable natural monuments are made, splendid in their dignity and grandeur. Instances are found in the Garden of the Gods, in Colorado, where pillars, towers, monoliths, arches, gateways, titanic newel posts and forms and shapes of every possible kind and design are seen—the work of frost and rain.

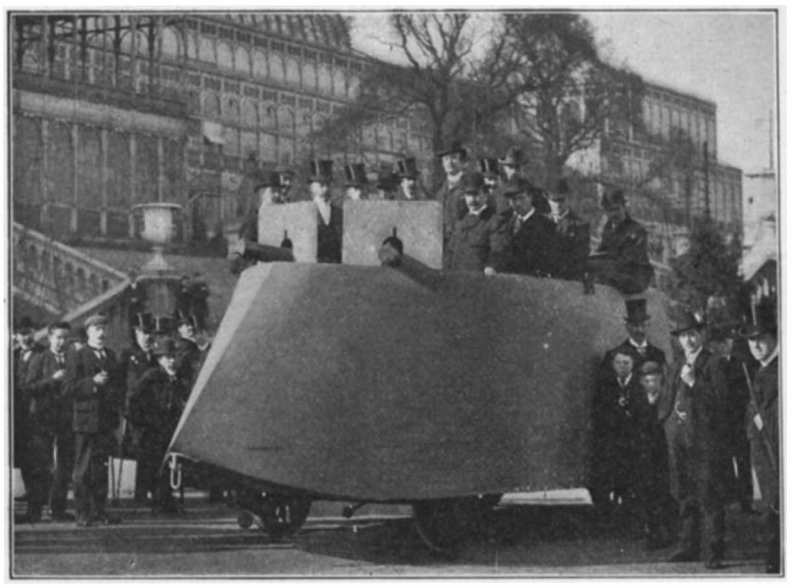
But it is further west that the most striking effects of erosion are found. In the region to the west of Salt Lake, and from there on, in what was formerly known as the Great American Desert, every overland passenger has been entertained by the weird and picturesque works of nature. Let but the fancy lead, and the eye rests upon cities, cathedrals, towers, minarets in the splendid buttes which rise everywhere along the line of public travel. They now appear silent and alone, gigantic monuments, or again in groups and clusters, rising on the horizon like ships upon the ocean; and it is not difficult to people these fantastic dwellings and imagine them the centers of human life. When the sun descends it paints them in marvelous hues—red, vermilion, yellow, and finally merging into purple and black in the quickening gloom. These strange forms, appealing so strongly to the imagination, are but the remains of past mountains, hills and plateaus. Rain floods have cut into and disintegrated them until all that remains is the core, or a harder portion that defies the elements and stands lofty and alone, a monument telling the story of the wear and tear of nature.

In New Mexico and Arizona there is still more striking evidence of this destruction. One should see it immediately after a contemplation of New England or the Middle States, where the country apparently has not changed materially in many centuries. The contrast is remarkable; the scenery bleak, rocky, barren, but with a charm peculiarly its own, a fascination few can resist. It is the land of the butte, and the lofty isolated mesa, the home of the washout, the cloudburst and violent outbreaks on the part of the elements, which in many regions appear to have wrecked the very face of the earth. Lofty buttes rise here and there, showing that in the past they have been the surface of a more or less level mesa which has been cut and worn by interminable floods until the very surface of the earth seems to have been washed away for hundreds of feet leaving the gigantic buttes, often acres in extent, to tell the story. Many of these are occupied by the native Indians who formerly used them as vantage points, and, when warfare and pillage are things of the past, still live there from mere force of habit.

One of the most interesting of the largest buttes is the famous Enchanted Mesa, which has been written up as a novelty by many modern writers and over which much discussion has occurred. This mesa is a type of extreme isolation and abruptness, the talus being so steep that ascent is extremely difficult to the average climber. This butte was inhabited ages ago, as all similar commanding positions, in all probability, have been, but, according to tradition, the means of descent were washed away by one of the cloudbursts, which made the mesa originally, and so it became uninhabitable.

A typical butte is well shown in the accompanying illustration—a rock pillar at Acoma, New Mexico, photographed by G. Wharton James. Harder than the rest of its surroundings, it has resisted the floods and rains of centuries, and stands, a gigantic monument to the resisting quality of certain portions of the surface. This pillar is merely a diminutive Enchanted Mesa. It may have been acres in extent at some early age, dwindling away with each successive year, the pillar being the heart or core of a sometime lofty and isolated mesa.

In the famous fossil forest of the Southwest the fossil trees often form interesting columns which have defied the elements. In Fig. 2 a pillar in this region is seen; not the trunk of a tree, but a column of shale piled layer upon layer which for some reason has resisted the elements and stands alone. Its base is fast disappearing, the talus even in the photograph being seen to be crossed and lined by the torrents which have poured down its sides and which ultimately will carry it entirely away, distributing it over the surface; and finally the column itself, weakened and undermined, will topple over and be reduced to its original composition of dust or gravel. Around the base of this pillar are seen the sections of fossil trees which have rolled down the slopes, telling a remarkable story of some change which has wiped out a great forest and devastated the land. In Mexico, not far from the island of Tiburon, there is a region undergoing a similar change and turning into a desert. The water is giving out; sand covers the land, but in it are found countless mesquite trees protruding here and there, showing that within the century the region has been well forested, as forests go in Mexico. But the land has been blasted, and the traveler over its burning and desolate areas may observe the actual change of a once fertile country into the typical desert.



THE SIMMS WAR-CAR.

An Interesting Discovery.

The German explorers in Babylon have made an unusually interesting discovery. Inscribed tablets of clay are common enough, and examples of them are to be found in the principal museums of Europe. But in the excavations at Nischan-el-aswad 400 tablets have been discovered, many of which are of a novel character. Several may be considered as of the belles-lettres class, says the Architect. They were evidently used for teaching, and therefore may be regarded as presenting examples of the Classic literature of Babylon. Some served as a dictionary, and on that account will be interesting to philologists. There is also a hymn which was chanted during the processions in honor of the god Mardik, whose temple has been brought to light by the German explorers. In another part of the same district the Temple of Adar or Ninev, the protector of physicians, has been discovered.

SERPOLLET'S RECORD-BREAKING STEAM RACER.

Automobile Department

THE NICE RACES.

Among the principal automobile events at Nice were the mile and the kilometer (0.62 mile) dash, the latter for the Henri de Rothschild Cup. These two events were run at the same time, and the automobiles after starting were chronometered at the kilometer and when required, at the mile points. The kilometer dash has been of especial interest this year owing to the record made by M. Serpollet of the kilometer in 29 4-5 seconds, and also of the general high speeds which were reached. M. Serpollet used a racing machine of special form, which will be observed in the engraving. It is a 12 horse power steam machine of the flash-tube boiler type, somewhat modified as to details. The front is formed of a sheet-iron cone which lessens the air resistance. The inventor considers that at such high speeds it is more essential to diminish the air resistance than to increase the power of the machine. Most of the racers used the machines which had been prepared for the Nice-Abbazia long-distance run, and it was interesting to see how these behaved on a short speed test. The best time for the mile was made by Osmont on a single-cylinder De Dion motocycle, which covered the distance in 57 4-5 seconds. The Mercedes 40 horse power machine built by the Daimler Company carried off the honors of the automobile class and the Darracq 20 horse power for the light automobiles.

The kilometer dash for the Henri de Rothschild Cup included automobiles from 1,430 to 2,200 pounds' weight, with two places occupied. The cup, a handsome work of art now on exhibition at the Nice Club, was won in 1901 by M. Serpollet, the time being 35 4-5 seconds.

THE SIMMS ARMORED WAR-CAR.

Vickers' Sons & Maxim, the well-known English armament manufacturers, have built a war-car, the invention of Mr. Frederick R. Simms, an expert who has devoted many years' experiments to this particular subject.

In general appearance the car can be described as a "mobile conning tower." It measures 17 feet in length, by 6 feet 2 inches in width over all, and has been designed to carry a maximum weight of 12 tons, though the actual weight to be carried will rarely exceed 6 tons. It consists of a rectangular frame constructed of heavy steel channels of U section. It is built with the intention of combining the maximum strength with the minimum of weight.

The special frame on which the motor, and speed differentiating gears are supported, is mounted on the car frame, and is built of Mannesmann steel tubes, the motor frame being supported to the main frame of the vehicle by suitable brackets and stays. The car is propelled by means of a 16 horse power four-cylinder light hydrocarbon motor of the Daimler type, fitted with the Simms-Bosch magneto-electric ignition and timing gear, with constant-level float-feed carbureter and governor acting on the exhaust valves. The bore of the cylinder is 90 millimeters, the stroke is 130 millimeters, and the compression 60 pounds per square inch. The motor is placed in the center of the car deck.

Petroleum of a specific gravity of 0.680 to 0.700 is the fuel used, but ordinary common kerosene of a specific gravity of 0.860 can also be burned if desired.

The cooling is effected by means of the Cannstatt marine type cooler—a copper tank containing about 5,000 copper tubes, through which air is induced by means of a fan rotated by the engine. The circulation of the air-cooled water between the cooler and the engine is kept up by means of a rotary gear driven pump. The water capacity of the cooler is four gallons, which is considered to be sufficient for at least 1,000 working hours. The engine runs normally at 750 revolutions per minute, but when the accelerator, with which it is equipped, is brought into action by means of a foot lever the velocity can be increased to 1,000 revolutions or more per minute.

The transmission of power is effected by means of a friction cone direct through a short end of shafting to the speed-changing gear, the female cone being developed as the flywheel of the engine, the male part being movable, and operated by means of a foot lever

throwing the power in and out of gear. The car is provided with a special gear of four definite speeds, i. e., 1½, 3, 5, 9 miles per hour. With the accelerator, however, the speed of the car can be increased 25 per cent.

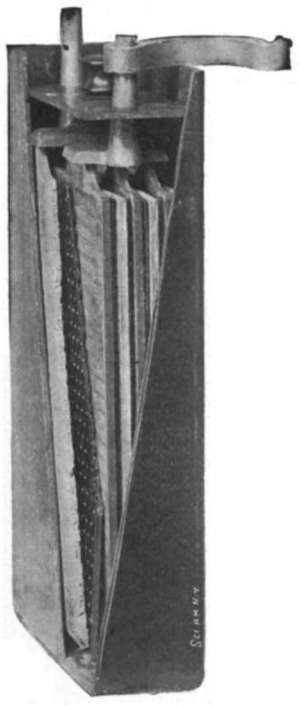
The steering gear is of the Ackermann type, controlled by a hand wheel and worm gear. The car is equipped with ample braking arrangements. The car, in spite of its weight, may be brought to a dead stop when going at full speed within six or eight yards. The road wheels are protected in case of war by chain mail, although this precaution is scarcely necessary, as the main armor belting is only 18 inches off the ground.

The tank contains sufficient fuel for 200 miles.

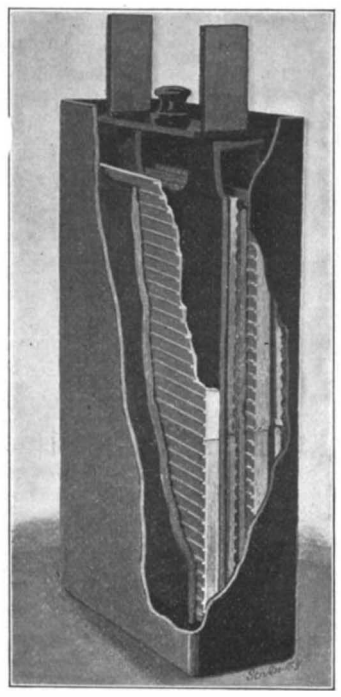
The most important feature of the car is the armor protection. The armor is so designed and constructed as completely to encircle the car frame. The bow and stern of the car are ram shaped, the angle of the nose being about 45 degrees. The extreme length of the armor, which is 18 inches off the ground, from point to point of the ram, is 28 feet. The extreme beam is 8 feet, and the extreme height 10 feet. The armor is of 6-millimeter Vickers steel, and is impervious to small arms. It is attached to the car frame by means of semi-elliptical springs, onto which it is hung by stout brackets. The four semi-elliptical springs are mounted on steel trestles, suitably braced and stayed to the main frame. By this it will be seen that the armor is not rigidly fixed to the frame. On the contrary, it has been the aim of the designer to separate the armor from the car frame itself in order to obviate the detrimental vibration imparted by the road wheels to the frame. The front and the rear of the armor serve as stores for ammunition, being boxed in underneath. Both rams are fitted with couplings, and are connected with tie rods direct to the main axles, so that in case the war-car is used for haulage almost a straight axial pull is obtained. The inside top edge of the armor is provided with half-embedded rollers, so as to prevent boarding, it being impossible owing to these rollers for any hand to obtain a hold on the top of the armor.

The armament of the war-car comprises two pom-poms and two automatic quick-firing Maxim guns fitted on proper gun mountings, either in turrets or without. In the latter case the guns are equipped with shields, and the mountings are so constructed as to lower or raise the gun in or out of action. If necessary 6-pounder guns may be carried. The ammunition stores carry some 10,000 rounds or more. The car is worked by three or four men, the number depending on the number of guns carried. There is sufficient platform room, however, for 20 men.

Only one man is required to drive and steer the car. The hill-climbing capacity of the vehicle is 1 in 7½ with a full load. Sufficient fuel for 500 miles may be carried. The total weight of the car complete, with armor, guns and fuel, is 5 tons 12 hundredweight.



THE PORTER CELL.

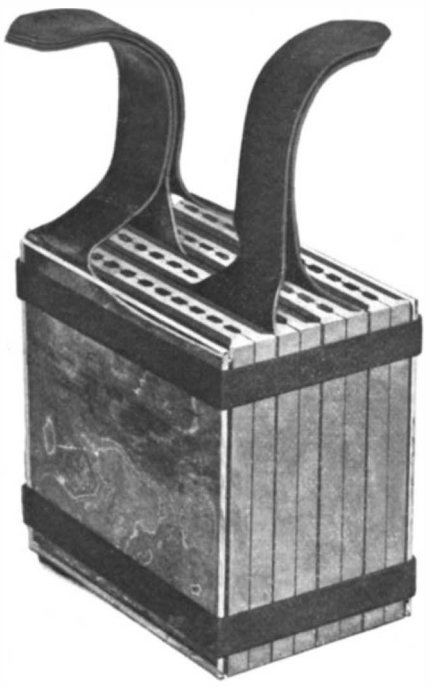


GOULD AUTOMOBILE CELL WITH EARTHENWARE SEPARATOR.

SOME MODERN AUTOMOBILE ACCUMULATORS.

The accompanying illustrations give a good idea of the construction and appearance of some typical storage battery cells used in the present-day electric vehicles.

Heretofore all practical storage cells have been constructed of lead, either from solid lead sheets or by pasting a grid with oxides of lead. These were called the Planté and Faure types of plates after their respective inventors. Another kind of storage cell is now being perfected by Mr. Thomas A. Edison, in which the active material is composed of iron and superoxide of nickel, which are formed into briquettes and pressed into very thin sheet steel frames. The plates are assembled in an electrolyte of caustic potash. The first machine-made cells of this new type have just been completed, and, after they have been thoroughly tested in vehicles, the Edison Storage Battery Company expects to place them on the market. The principal advantage of the nickel-iron cell over the lead one is that in it there is no rotting action due to the successive oxidation of the positive plate, and hence, theoretically at least, there should be no deterioration, while the weight of the cell is nearly half that of the most durable lead cells, the capacity in watt-hours per pound of total weight being about 14. A disadvantage is found in the lower electromotive force, however, which averages 1.25 volts against 2 of the lead cell. This means that nearly double the number of cells will be required to obtain the necessary voltage than are at present needed with the lead battery.



THE COMPLETE BATTERY.

UNPASTED GRID.

PASTED GRID.

THE INTERNATIONAL BATTERY.

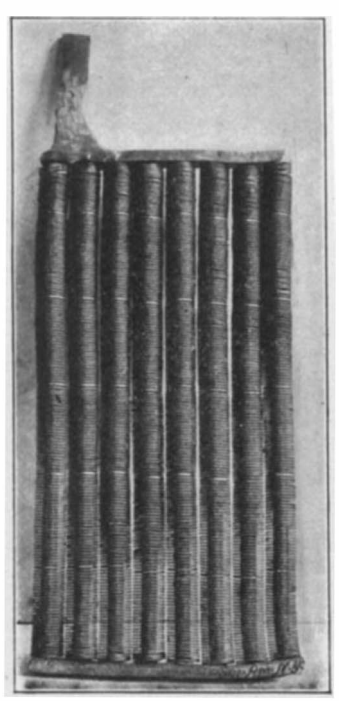
A typical example of the lead battery formed from lead sheets will be found in the Gould cell. The plates of this cell are very finely grooved by rotating steel disks, which cut into the lead and crowd it up without removing any of it. An exposed surface 17 times that of the smooth plate is thus obtained, and this is what determines the capacity. The plates are made with fine or coarse grooves, according to their size and the work they are intended for. A cell built on this plan, the largest ever made, was exhibited at Buffalo, N. Y., last year. The dimensions of this cell were 9 feet long, 2 feet wide and 4 feet high. It contained 100 plates 15½ by 31 inches in size, immersed in one ton of sulphuric acid solution, and weighed 8,750 pounds. It gave 16,000 ampere hours at an 8-hour discharge rate or 8,000 ampere hours when discharged in one hour. The cut shows a 7-plate automobile cell, which has a capacity of 90 ampere hours at the 3-hour rate, and weighs complete 28½ pounds. This gives it a total energy value of 6.27 watt-hours per pound. Hard rubber perforated ribbed separators were formerly used in this cell, but at present an improved porous earthenware separator is substituted that is said to possess several advantages.

Mr. A. F. Maddern, the inventor of the form of plate used in the above described cell, has recently succeeded in stamping plates from lead sheets in an hydraulic press of novel design. The intricate lead grid and plate seen in the illustrations were produced under a pressure of 250 tons to the square inch. This gives a homogeneous conductor with the largest possible effective surface per unit of weight in contact with the active material. Such contact is always assured in cells of the pasted type, since the small figures or points of the grid can bend slightly to conform with the expansion and contraction of the active material. The grids are so rigid and the active material adheres so well, that the only separator used consists of four hard rubber strips which fit in grooves in the four vertical bars of the frame. These batteries have been manufactured by the Auto-Dynamic Company, and received a thorough testing in pleasure vehicles and delivery wagons during the past year and a half. At a three-hour rate of discharge, a 90 ampere-hour cell gives something over 8 watt-hours per pound. The company are now preparing to manufacture the Planté type of plate shown in one of our illustrations.

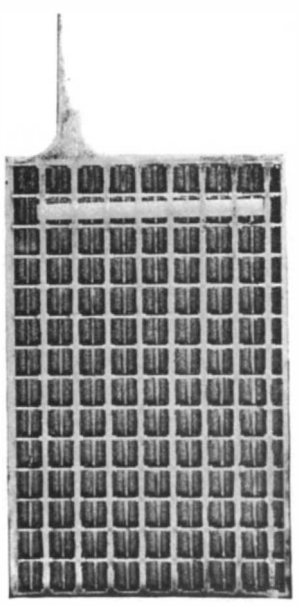
A battery that was invented three years ago by Mr. F. W. Barhoff, of Hartford, Conn., and which has been thoroughly tested in a vehicle for 13,000 miles, is constructed from lead rods which are grooved or cut into washers, leaving sufficient lead to form a solid core. These rods are then assembled so as to form plates. This battery has held up remarkably well in the endurance test given it, as it only fell from 8.47 to 5.049 watt-hours per pound during the three years it was in service. The Hartford Auto and Livery Company are preparing to manufacture this battery, which can be produced cheaply and yet is believed to have greater durability than any of the other batteries now on the market.

The National Battery Company have just completed a new light-weight cell of the Planté type which is said to have a capacity equivalent to about 14 watt-hours per pound.

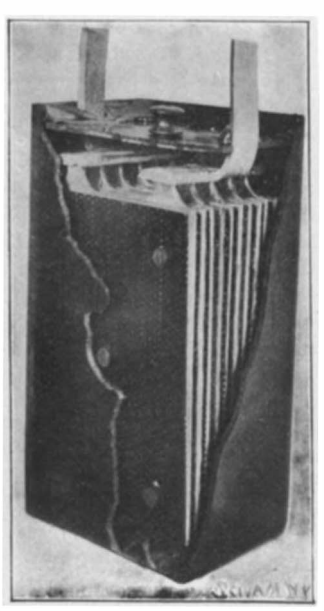
The American Battery Company, of Chicago, make a durable cell somewhat sim-



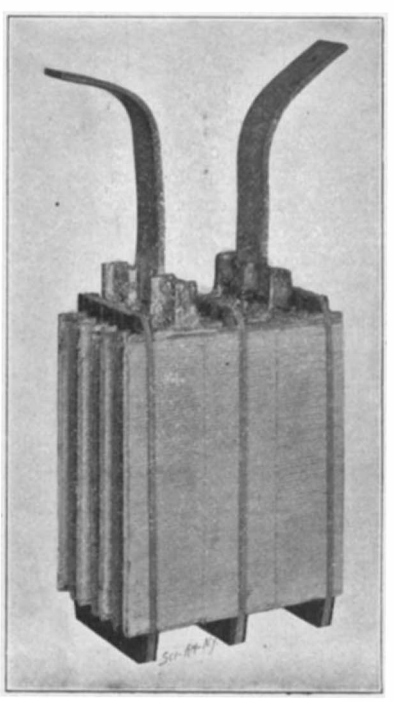
BARHOFF BATTERY PLATE.



REUTERDAHL PLATE.



REUTERDAHL CELL.



AMERICAN BATTERY ELEMENTS.

ilar to the Gould; but in this instance the lead sheets are grooved at an angle by a cutting tool and the lead is cut away. This gives a cross-sectional view of the plate the appearance of a series of superposed V's with a vertical stem passing downward through the apex of each. The automobile cell that gives 27 amperes for three hours weighs 30 pounds, which is equivalent to 5.47 watt-hours per pound.

Of the Faure or pasted type of cell the Porter is one of the lightest at present on the market. The construction of this cell is shown in the illustration. The plates are very light and are made to a standard size of 5 by 7 inches, ⅛ inch thick. A 21-pound cell has a capacity of 96 ampere-hours at the 3-hour rate, which corresponds to between 8 and 9 watt-hours per pound. This company guarantees their batteries for a term of years for 20 per cent of their original cost. The positive plate is good for 360 complete discharges, after which it has to be renewed.

The construction of the International Storage Battery Company's cell can be plainly seen from the illustrations. The two grids of porous earthenware are pasted with the usual lead oxides, after which they are clamped and cemented together with a conducting sheet of lead between them. The grids have parallel ribs on their outer faces, which press against similar ribs on the next plate and hold the plates apart. The earthenware grids, besides being insulators, hold the active material firmly in place, so that it cannot possibly fall out. It certainly would seem impossible for deterioration to occur in this cell from loss of active material.

The Perret battery, the invention of Mr. Frank E. Perret, is one of the lightest and neatest cells that have yet been produced. It is made upon the unit system, similarly to the Barhoff. Each unit consists of a perforated rectangular casing about a quarter of an inch square and 6 or 8 inches in length, filled with special electro-chemically prepared active material. This material is formed from pure lead in a bath of pure dilute sulphuric acid, thus eliminating all deleterious substances that usually creep in through forming solutions. Each Perret unit has a definite capacity, and it is only necessary to assemble the proper number to get any sized cell desired. The 100 ampere-hour cell at the 5-hour rate weighs 15 pounds, which corresponds to about 12½ watt-hours per pound.

The Haschke battery, made by Mr. J. E. Haschke, of Chicago, is a very light automobile cell that has given good results in service. The principal feature of this battery is a chemically prepared cardboard envelope that surrounds and separates the plates, thus making short circuits practically impossible. The cell will stand great abuse in the form of heavy discharges without materially damaging it.

The Reuterdahl battery, the construction of which is shown herewith, is, according to the claims of the makers, the lightest battery that has yet been produced. The grids are made of a special lead alloy which combines lightness with rigidity and ability to withstand electrolytic action. The grids are so shaped as to form a perfect trusswork within the plates, which counteracts any tendency to buckle. In making the negative plates spongy lead is deposited together with a secret chemical substance, thus forming an electrolytic alloy. This is compressed by hydraulic pressure and afterward the foreign substance is dissolved out, leaving only spongy lead in an extremely porous condition and in good electrical contact with the grid. The positive plate is similarly formed, the grid being first electrically coated with a layer of lead peroxide. The separator used in this cell is a perforated sheet of hard rubber having horizontal leaves or shelves on which glass wool (an insulating substance unaffected by electrolytic action) is wound. This allows a free circulation of the electrolyte and at the same time provides a flexible pad which retains the active material in place and prevents it from shedding and short-circuiting the cell.

A 3-hour discharge curve of one of these cells shows a remarkably high voltage, which does not fall to 1.9 volts until the end of 2¾ hours. The capacity in watt-hours per pound of complete cell at this rate is given as 16.74, which is quite a little higher than that of the new Edison cell. We have been unable, however, to substantiate these figures.

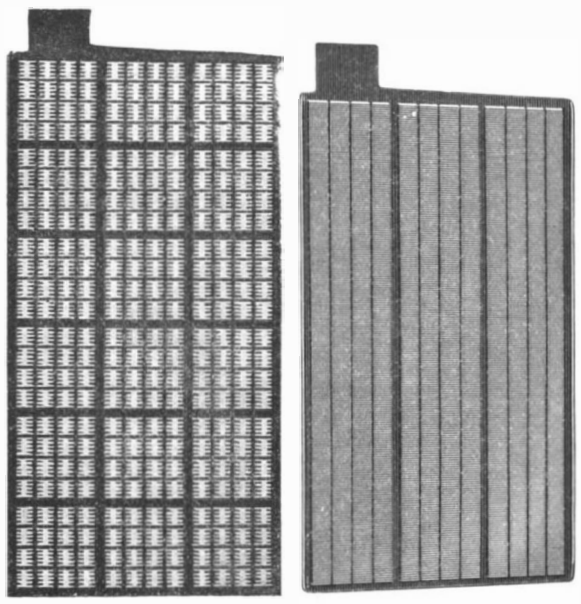
Comparative Braking Tests Between Horse-Drawn Vehicles and Automobiles.

The Automobile Club of America held a braking contest recently in order to demonstrate to the Law Committee of the Board of Aldermen of this city the ease with which an automobile could be stopped as compared with a horse-drawn vehicle.

The results of the test show that at speeds in the neighborhood of 20 miles an hour an automobile can be stopped in about half the distance necessary to bring a horse-drawn carriage to a standstill, while at 7 or 8 miles an hour the automobile requires from two-thirds to one-half the space needed by the latter. At the low speeds of from 7 to 8 miles per hour, which latter is at present the legal limit in New York, the heaviest of the autos could be brought to a stop in from one-half to three-fourths its own length. As an example of this, 1,400 and 2,500 pound machines, traveling at 7.6 and 7.2 miles per hour, were stopped in 4 feet 9½ inches and 6 feet 8 inches, respectively, while an 800-pound machine, going at 8.7 miles an hour, required but 8 feet 9 inches.

The horse-drawn vehicles consisted of a four-horse coach and a two-horse victoria. The former, traveling at 16.3 miles per hour, was stopped in 77½ feet, against 34½ feet required by a French gasoline machine going at 18.9 miles an hour; while the latter, when driven at 13.8 miles an hour, was stopped in 36 feet 10 inches.

The tests prove, distinctly, the superiority of the automobile so far as stopping quickly is concerned, and they should do much toward promoting the framing of a more liberal speed law, in which the motor-driven machine should be allowed more nearly the maximum speed at which it can be brought to a stop within the distance required by a horse-drawn vehicle when driven at 8 miles an hour. The danger to pedestrians is no greater from the pneumatic-tired wheels of an auto than from the iron-shod hoofs of a fast horse, and the auto should be given equal rights on the road, based on the distance in which it can be stopped.



THE MADDEN STAMPED LEAD GRID AND PLATE.

Automobile News.

The necessary permission having been obtained from the Board of Aldermen, the Automobile Club of America will hold on May 31, on the South Shore Boulevard, Staten Island, a mile record contest, open to motor vehicles of all classes. Gold and silver medals will be awarded respectively to the vehicles making the best and second best time in each class.

The suppression of the Nice-Abbazia race has been severely felt by the organizers of the event and the great number of manufacturers who had gone to a considerable expense in constructing machines especially for the race. The reasons why the Italian government refused at the last moment to grant the authorization are not very clear. It is supposed that the authorization had been granted at first by the Minister of Public Works, and that subsequently the Minister of the Interior placed his veto upon it. The reason for the latter decision is said to lie in the fact that an important market is held at this season at Coni, one of the towns along the route, which attracts the population from all over the north of Italy, hence the roads, which are narrow, would be greatly encumbered with vehicles, and the race would be dangerous under these conditions. This does not, however, explain why the race could not have been postponed to a later date. Another explanation is that a number of chauffeurs started out to explore the route in advance, and did some damage along the way, from which resulted a number of protests, and finally led to the action of the Minister. This decision has been a severe blow to the French automobile industry, and will result in the loss of millions of dollars which have been spent by the leading manufacturers, not only in the designing and construction of the special racing machines, but in the distribution of supplies along the route. M. Serpollet estimated that his company has lost $50,000, two months of work, and $2,000 worth of petroleum which had been distributed through the north of Italy, together with a numerous personnel.

Legal Notes.

The First Wireless Telegraphy Suit.—At last one of the many quarrels between rival inventors of wireless telegraphic apparatus will soon be definitely settled. Siemens & Halske, the makers of Braun's apparatus, have taken the bull by the horns and have begun a suit for infringement in Germany against the Allgemeine Elektricitaets Gesellschaft, who own the Slaby-Arco patents. It is rumored that the Braun system, for which Siemens & Halske stand as sponsors, is nothing but a Germanized Marconi system, and will, therefore, fare rather badly in litigation. At all events, it is certain that the German government distinctly favors the Slaby-Arco system. The Marconi Company, whose stock organization in America was recently announced, will probably soon have to test its rights in the United States courts. But since the Marconi system has already passed through one patent suit unscathed, the chances are that it will come out of others with equal success in America.

Unfair Competition.—Where the attempt is made so closely to imitate a competing article as to confuse and deceive purchasers the courts will not be nice in limiting the scope of the relief granted because some of the imitations if practised singly and without fraudulent intent might not constitute unfair competition; and, when unfair competition has been found, the courts should not give their approval in advance to any suggested or proposed changes, leaving to the defendant the responsibility of deciding for himself what changes are necessary to avoid further infringement. (112 Fed. Rep. 1000.)

Dayton Electrolysis Case.—After a trial lasting some weeks, in which testimony covering several thousand typewritten pages was taken, a decision was rendered in the case of the Dayton City Railway Company, of the same town, in the Court of Pleas. The case is of peculiar legal interest, for the reason that entirely new questions of law were presented for the consideration of the Court. Of the numerous witnesses thoroughly examined and cross-questioned, twenty were experts selected from the leading authorities of the United States in the branches of electric, hydraulic, chemical, mechanical and street railway engineering. All these experts were called upon to discuss the electrolytical effect of a return trolley current. The city claimed that the company had not used proper means for returning the current to the power house, by reason of which neglect water pipes had been badly damaged by electrolysis. The opinion is too lengthy for republication. Its main point can, however, be given in brief form. The court states that the right to use streets for waterworks is granted by the legislature, that the right of an electric railway to use the streets springs from the same source. The electric railway and the waterworks are both beneficial to the public, and their proprietors are entitled to enjoy their respective rights without interfering with each other. No conflict can occur where each confines itself to its own sphere of activity. The city of Dayton made a contract with the company in 1892 for the construction, operation and maintenance of a single-trolley electric railway. The law will not permit the court of Common Pleas under the circumstances to direct the adoption by the company of the double-trolley or conduit system; for the legal doctrine that a man must enjoy his own property in such a manner as not to injure the rights of another, led the court to the conclusion that where contract relations have been authorized by the legislature between the parties, and there has been a proper exercise of such grant, no cause of action will lie against the party exercising such franchise or right under the contract or statute, provided that due care has been used. The facts determined are that the soil underlying Dayton is of such a character as to subject it easily to electrolytic action, but that it is not of a nature to cause corrosion similar to that on pipes; that pipes buried in the soil remain unaffected for thirty years if not subjected to electrolysis; that this electrolytic action upon water-pipes is caused by the operation of a single overhead trolley railway; that the damage suffered by the city could be remedied by the installation of a double-trolley system, which would prevent electrolytic action upon the water-pipes of the city, and that the railway has been operated in a very inefficient and negligent manner, far below the standard of the electrical art. The court, therefore, held that it was its duty to enjoin the defendant "from so operating its railway, and to compel it, within a reasonable time, to introduce such improvements in the system in order that the operation of the single-trolley system authorized by the franchise and contract will be in accordance with the present standard of the art of operating single-trolley roads. The plaintiff shall co-operate to that end."

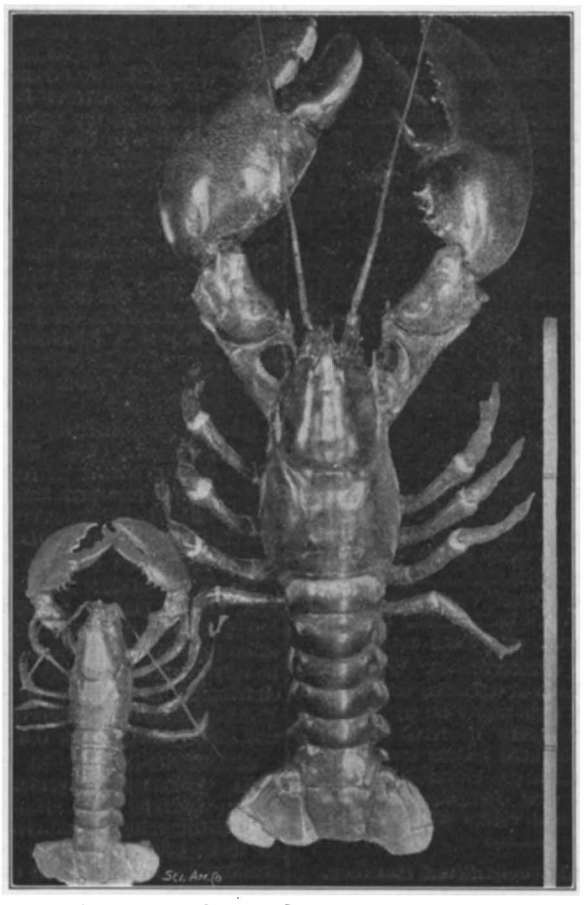
MONSTER CRUSTACEANS AT THE AMERICAN MUSEUM OF NATURAL HISTORY.

BY WALTER L. BEASLEY.

The American Museum of Natural History has just acquired a unique wonder of marine life in the shape of a gigantic Japanese crab, measuring 12 feet. This is the largest specimen in the world, the Biological Department of Columbia University having the next in size. The specimen shown is a type of the spider crab, which inhabits the waters of the group of islands forming the empire of Japan. At four of these great islands, at present, according to Prof. David Starr Jordan, some 1,100 different marine species are known to exist. The extraordinary size of the crab is strikingly shown in comparison with the ordinary-sized one; the body portion is of about the size of a large dinner-plate, while its two great arms, containing saw-like teeth, called "pinchers," could encircle the outstretched figure of a man. The eight arms resemble sections of bamboo growth, and are extremely elastic. One of the peculiar features of the crab is its faculty of assuming a disguise. This feat they are able to perform owing to the flexibility of their pinchers, and to the hooked hairs and spines with which their numerous arms are studded. By means of these pinchers they tear off small fragments of sponges and seaweeds. After first putting these to their mouths, which contain a glutinous saliva, they place them on the surface of their limbs and body, by sticking them fast with a rubbing movement. By this method the crab succeeds in completely changing its appearance and rendering itself indistinguishable from the materials common to the bottom of the sea. The big crab is one of the features which Prof. H. C. Bumpus, Curator of the Department of Invertebrate Zoology, is arranging for exhibition.

Another monster now on exhibition at the Museum is a gigantic lobster, estimated to be the largest specimen in the world thus far recovered. It is a species of the common marine lobster, *Homarus Americanus De Kay*, and was caught off the Highlands, New Jersey, by fishermen. This immense crustacean measured nearly a yard in length and weighed thirty-four pounds. When first captured it was exhibited at the New York Aquarium, but only survived a few days. On account of its unusual size it was afterward obtained by the Museum and mounted for permanent preservation. It now forms one of the most striking exhibits in the biological collection; it was also a prominent feature in the United States Fish Exhibit at the Paris Exhibition. Although of such extraordinary size, the lobster was quite normal in all its parts, being simply overgrown.

In this connection it may be said that an important discovery bearing on the lobster industry has just been announced by Prof. H. C. Bumpus, of the American Museum, who states that the problem of artificial lobster culture has been conclusively demonstrated. This new and far-reaching discovery places the United States ahead of all the nations of the world in this particular branch of biological investigation, as for years the artificial propagation of this crustacean has baffled the leading scientists abroad. The supply of lobsters has been slowly diminishing during the past five years. It was apparent to the United States Fish Commission that unless some active means were taken to increase the production the lobster would, in a few years, become practically extinct. Prof. Bumpus, who has been conducting investigations in this line at the Wood's Holl Laboratory in the past, was appointed to take charge of this work. The practical experiments, which have yielded a series of surprising and brilliant results, were carried on at the Wickford, R. I., station of inland fisheries, on board the new floating laboratory or houseboat, which was especially adapted for practical work. After numerous experiments had been made it was found that the secret of success in rearing the young lobsters from the eggs was to keep the water in continuous motion, thereby preventing the fry from settling into pockets to smother or devour one another; as at certain times they have a tendency to leave the surface and sink to the lower depths, this resulting in great mortality. Dr. A. D. Meade, of Brown University, and the Director of the Wickford Station, originated the continuous motion idea and carried on the practical details of the work. A simple and ingenious stirring and feeding apparatus was constructed, consisting of several cylindrical scrim bags, 3 feet in diameter and 4 feet deep. Mr. George H. Sherwood devised and installed this contrivance. In the central space or pool of the houseboat were submerged a dozen or more of these scrim bags, containing several thousands of the young fry. In each bag was placed a dasher, turned by a gasoline engine, the rotating blades of which would constantly keep the water so agitated that the fry would not and could not settle to the bottom. The blades also kept the food in circulation, so that the fry could obtain it. The apparatus sufficed not only for keeping the fry and artificial food from the bottom, but it also provided the fry with living natural food. They were fed with the soft parts of clams, cut into fine pieces in a chopping-tray. This diet seemed best suited to the young lobster's digestion. The experiments proved that lobsters can be artificially reared from the eggs until in nine to sixteen days they pass the critical stage, after which they become similar to the adults in structure and habits, being able to take care of themselves when liberated. Dr. Meade reports that by actual count in no case was the number of lobsters that reached this stage less than 16 per cent of the number of fry originally placed in the bags. In many cases it was above 40 per cent, and in one instance it was as high as 54 per cent. In previous years no experiments had yielded more than a fraction of 1 per cent. Encouraged by these results the United States Commission of Fish and Fisheries is now planning to equip several stations along the New England coast with the new hatching and brooding apparatus for the purpose of raising millions of fry. The liberation of large numbers of these hardy youngsters will result in the re-stocking of our depleted waters, thereby saving the lobster industry from extinction.

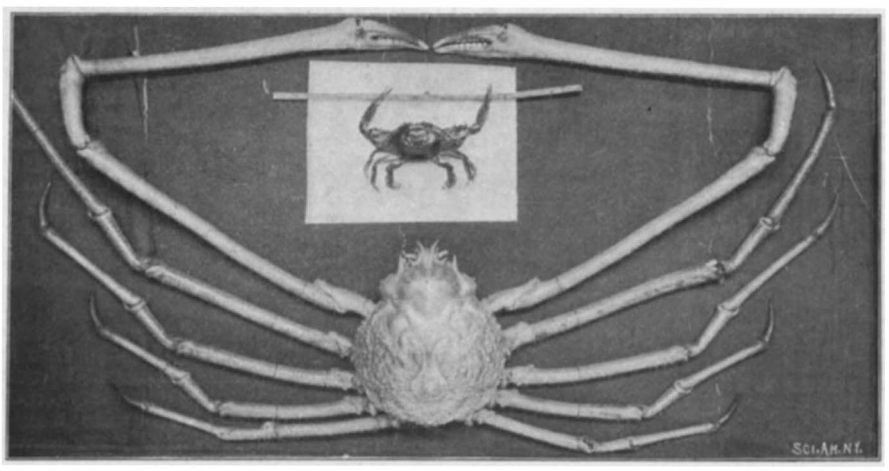


Caught off the Highlands, New Jersey. Length, 3 feet; weight, 34 pounds. Now in American Museum of Natural History, New York.

THE LARGEST LOBSTER ON RECORD.

Anthracite in China.*

Examination of the fossils which were brought from the southern provinces of China has been made under the direction of M. G. Vasseur, Director of the Geological Laboratory of Indo-China.



THE LARGEST CRAB ON RECORD.

The researches have proved that there are in several parts of the provinces of Yun-nan and Koni-tcheon, Devonian schists very rich in fossils. The species most abundantly represented in these beds are: streptorhynchus, orthis, rhynchonella, pentamerella, pentamerus, cyrtia, atrypa, athyris, with trilobites and débris of fishes.

The village of Lan-mon-tchang, in Koni-tcheon, is situated about half way between the districts of Hing-i and Gan-chuen. Here is a coal mine, worked by the Chinese. The strata of coal are intercalated with schists in a circular elevation. The schists vary in color from clear gray to an almost blackish gray. They are covered with a calcareous formation.

The inclination of the coal measures is about 20 deg. toward the northeast. The enveloping rock is rich in organic débris. The fossils in the floor and roof of the carbonaceous strata are identical. They are chiefly brachiopods of the species streptorhynchus. This order is represented in quite a variety of genera, which appear to be for the most part peculiar to this formation. Some trilobites are also found here, and attention should be especially called to the genus Phacops, which in connection with other fossils, indicates indubitably the level to be assigned to the sediment inclosing it, and consequently to the coal deposits interstratified in these formations.

As might be expected from the age of the beds, the coal of Lan-mon-tchang is an anthracite. Its analysis, made by M. Estienne, engineer-chemist of the Worms firm at Marseilles, is as follows: water, 0.50; volatile matters, 8.75; ash, 10.40; fixed carbon, 80.35; total, 100.

The proportion of ash is quite high. This is probably due to the presence of sulphur.

This mineral exists in the vicinity of the bearings. Iron pyrites is also found in the schist. In the calcareous strata covering the schist, a small crevice lined with cinnabar has been worked by the Chinese.

This is a very important anthracite bed. It is worked by means of three very narrow galleries, of which one has a depth of about one and a half kilometers.

Lan-mon-tchang is the only point where fossils have not been found clearly Devonian in contact with coal. But this proves nothing except that beds of the same age do not exist elsewhere. Several deposits of fuel appear in stratigraphic conditions absolutely similar to those which I shall take occasion to describe. At least in one point, a coal bed exists incontestably Devonian.

M. Zeiler, engineer-in-chief to the Society of Mines, has already shown, that, according to the samples brought by M. Leclère and M. Monod, China contains numerous coal beds of unequal value; some of them belonging to the carboniferous strata, others to a lower formation, and the middle to the Jurassic period.

The Lan-mon-tchang bed proves that the vertical extension of coal is greater than formerly supposed. This extension would be augmented still more, if the tertiary lignite found at Ma-pé-kai, in the east of Yun-nan, should be taken into account. These lignites are accompanied by a complete fauna of lacustrine gasteropods, among which the phanobis predominate. From the works of M. Zeller, it seems that lignites, probably Pliocenes, exist also at Tonkin, in the Yen-Bay region, where they are inclosed in the sand-clay schists with tulatomes and vegetable dicotyledons.

Thus it is evident that coal was formed in China in the Devonian and Carboniferous eras, during a part of the Jurassic period and in certain tertiary lagoons.

* Paper of M. G. H. Monod, presented to the Académie des Sciences.

Power Lost in Flywheels.

The resistance which a flywheel offers to the air may give rise in some cases to a considerable expenditure of energy. Some tests were made in the Nürnberg central station which showed this very clearly. The station is provided with two tandem compound engines of 450 horse power, direct coupled to the dynamos and working at 95 revolutions per minute. In order to equalize the running with the great variations of load which occur, a very heavy flywheel was used with arms of a channel section. It was found that these arms offered a great resistance to the air, and created a powerful draft, and so it was decided to cover the wheel with sheet iron in order to reduce the resistance and thus gain considerable power. In order to test the amount of energy lost, the dynamo was made to run as a motor and thus drove the engine and flywheel at no load. When the latter had no protecting covering it was found to absorb 13,300 watts, but when the covering was replaced it took only 9,874 watts, thus showing a gain of 3,426 watts or 5.7 horse power, this being 1.2 per cent of the power of the engine. Counting the current price per kilowatt hour and a day's run of 17 hours, it was found that this represented an economy of nearly $270 annually. Another test of a similar nature was made by M. Ingliss upon a 630 horse power engine and showed an economy as high as 30 horse power or 4.8 per cent of the engine power which was gained by properly diminishing the resistance of the flywheel.

The monkey wrench gets its name from its inventor, Thomas Monkey, of Bordentown, N. J.

RECENTLY PATENTED INVENTIONS.

Agricultural Implements.

ADJUSTABLE CULTIVATOR - ARCH. — CARL CHRISTENSEN, Clifton, Ill. The invention is an improvement on that part of a cultivator frame which is made in twin sections that straddle a row of plants and are connected by an elevated arch in the middle. The shovels have an independent up-and-down movement which will allow the cultivator to be tilted to one side and either foot of the arch raised without tilting the other foot.

PULVERIZER.—J. R. JONES, Jackson, Miss. The pulverizer provides a suitable roller for mashing and smoothing the soil, and is adapted to the greatest variety of purposes. The machine is so constructed that it may mash down plants that are to be destroyed by being covered up by the cultivating teeth which follow the roller, and such plants as are desired to remain and the soil will be left in the best cultivatable condition.

DRAFT-EQUALIZER.—T. F. and J. J. FOLK, Burton, Okla. Ty. This invention provides a novel construction of four-horse equalizer which is especially adapted for use on binders and aims to avoid as far as possible the side draft incident to the use of grain-binders, as is well understood by those skilled in the art.

Apparatus for Special Purposes.

APPARATUS FOR CHARGING AND DISPENSING LIQUIDS.—C. A. WILKINSON, Worcester, Mass. By means of this apparatus the water in a soda-water fountain is charged with the gas employed as fast as it is used, a mixing and charging device being comprised in the apparatus. After the water is charged it is led to a reservoir fitted with a gage so that the height of the water may be readily discerned. The reservoir is also fitted with a siphon for drawing off the charged liquid.

WATER SUPPLY AND FILTERING SYSTEM.—L. E. SMITH, Portsmouth, Ohio. The chief requisites for the water supply system for cities are due quantity, maximum purity, and moderate cost for installation and repairs. This apparatus is so constructed as to fulfill these requirements. A natural deposit of sand or fine gravel in a river or lake bottom is availed of as a filtering medium.

APPARATUS FOR THE HYDRAULIC PROPULSION OF SHIPS.—LÉON VIDAL, St. Rome du Tarn, France. The apparatus consists essentially of a jacket surrounding the hull of a ship and perforated with a number of slots arranged at a slant to the longitudinal median plane of a ship which is fitted with a pump for supplying water continuously into the space between the hull and the jacket. The flow of water through the slots acts on the surrounding water to propel the ship.

Electrical Apparatus.

ELECTRIC-ARC LAMP.—P. H. F. SPIES, Mt. Vernon, N. Y. The feeding of the upper carbon is exceedingly sensitive to insure at all times a uniform steady light and to permit convenient adjustment according to the power of the current. The construction permits the attendant to conveniently open and close the arc-lamp for removal of the carbon or for making repairs.

TELEGRAPH-SOUNDER.—J. A. ALBERTSON, Lansford, Pa. The receiving stroke of the telegraph sounder is made more prominent than the sound produced by the return stroke, so that it may be more readily recognized. This avoids any confusion that may arise due to similar strokes or sounds produced by the forward and backward movement of the vibrating arm.

ELECTRIC CLOCK.—E. MEYER, Jersey City, N. J. The invention relates to clocks driven by electricity and provides a new electric clock which is simple and durable in construction and very accurate in its working. Movement is given to the pendulum by the successive blows of a weighted arm which is raised by an electrical device.

Engineering Improvements.

ROTARY ENGINE.—S. D. BOOK, Bagley, Minn. The rotary engine is provided with a piston divided into a plurality of chambers in each of which works a piston, the steam pressing on the piston heads to act expansively therein. The valves in the several valve chests work continuously to introduce and then cut off the steam, permitting the steam to expand, and thus deriving from it the full force of its power.

BOILER-FEEDER.—H. G. LARCOM, New York, N. Y. In this invention the apparatus for feeding boilers is so arranged as to transmit the steam pressure of the boiler to the feeder, allowing the water to fall by gravity into the boiler. The desired height of the water in the boiler may be regulated by the elevation of the feeder. Should the boiler be full the water will simply be forced by the pump through a pipe back to the source.

SPARK-ARRESTER.—E. J. SMITH, High Springs, Fla. It is well known that artificial or forced draft is what causes a locomotive to throw fire or sparks, and this draft is on only when the throttle is open and the steam is in the cylinder. Mr. Smith therefore provides means operated by the steam for adjusting the spark-arresting devices in position to guard the stack, permitting the arresting devices to adjust clear of the stack when the throttle is closed, so an unobstructed natural draft is had when the engine is drifting or rolling or in firing up a cold engine.

HYDROCARBON-BURNER.—R. WITTY, San Bernardino, Cal. The burner is designed for use in steam boilers and the like to quickly and economically generate steam. In the burner, steam, oil and air are not only highly heated but are thoroughly mixed to form a very effective combustible mixture.

Hardware and Tools.

WRENCH.—L. W. JOHNSON, Jerome, Arizona Ty. In most wrenches the shank is weakened by the teeth extending across its upper face. In this wrench, however, the teeth are at the side and are engaged by teeth on the slidable jaw. This jaw is rockable on its center so as to be easily disengaged from the teeth when it is desired to adjust the tool to the size of the nut to be turned.

SAW-HANDLE CLAMP.—J. A. HALE, Rockville, Ind. The handle is attachable to the end of a hand-operated crosscut or ripping saw, and provides a novel device of the indicated character which is readily attachable or removable from a saw-blade, and which will reliably hold the same in connection with the handle.

LIFTING-JACK.—F. H. FORD, Jacksonville, Fla. This lifting jack is especially adapted for the repairing of the track of a railroad and is very compact, so that while affording a considerable range of elevation the projection above the rail of the track of any part of the lifting-jack is much less than a like projection of lifting-jacks in present use. Thus the operation of trains over track under process of repairs is much more safe from accident.

ADJUSTABLE WRENCH.—F. W. BROWN, Berlin, N. H. The tool embodies one or more sets of jaws that may easily be spread for a proper distance in order to receive nuts of different sizes. Suitable means are provided for securely clamping the movable jaw to its adjusted position, said clamping device being quickly tightened and easily released.

Machines and Mechanical Devices.

MULE.—F. REYNOLDS and W. J. UNDERWOOD, Fall River, Mass. The improvement relates to mules used in textile machinery, and more particularly to a buffer for cushioning the upward stroke or thrust of the part known as the jumper. The apparatus comprises a jumper, a revoluble roller connected therewith, and a spring-tension lever mounted in the path of the roller or cushioning the upthrust of the jumper. Means are also provided for adjusting the position of the lever relative to the jumper.

BUTTON-SEWING MACHINE.—R. R. WANLESS, New York, N. Y. This machine is designed for sewing shank-buttons on garments, and provides a simple device which can be adjusted to hold buttons of varying sizes. A cam movement is employed for shifting the needle-bar in such manner as to form extra stitches at the outer side of the shank, somewhat in the manner of hand-sewing, to prevent the drawing out of the thread.

FIBER-CROSSER.—P. MICKLE, Troy, N. Y. This device has reference particularly to machines for making paper from all kinds of fiber, especially rope and wood, and its object is to provide a new and improved fiber-crosser for use in the cylinder vat. It is arranged to insure a perfect crossing of the fabric in the pulp to cross the fibers in all directions, thereby forming a very strong and durable paper.

MAIL-BAG DELIVERER AND CATCHER.—G. R. BERRIEN, Princeton Junction, N. J. This mail-bag catcher is so arranged that no matter how fast a car is traveling, the several devices readily act in the proper manner to afford the delivery of a mail pouch from the car to the station, and to insure the pouch from the station being picked up by the car without the slightest danger of its being dropped, or the parts of the device being injured as is so frequently the case with the apparatus now in use.

MERRY-GO-ROUND. — B. KIPPELS, Moorhead, Minn. The merry-go-round belongs to that class of carousels which are propelled by the exertions of the occupants. An improved arrangement of seats is provided and a propelling mechanism is employed which is adapted for utilization of both hands and feet.

COIN-FREED GYMNASTIC APPARATUS.—K. STRAUSS, Wiesbaden, Germany. The invention provides a locking device in connection with the swinging beam of a gymnastic apparatus for releasing the same on the insertion of a coin and for locking the swinging beam after use. It also provides a gearwork for determining the duration of the use in proportion to the number and length of strokes of the swinging beam. It further provides means for taking up the force of the loads on the swinging beam, while the apparatus is locked, whereby these loads are prevented from damaging the locking device and the gearwork.

MACHINE FOR APPLYING GATHERING-STRINGS TO BAGS.—J. W. TAYLOR, Goldsboro, N. C. Bags for holding various substances, especially smoking tobacco, are commonly provided with gathering or shirring strings for closing their mouths. Such strings have usually been inserted by hand. The object of this invention is to entirely dispense with hand-labor for this purpose and to provide an improved automatic machine which will do the work in a quicker, cheaper and uniform manner.

CANE-FEEDING MECHANISM FOR CANE-MILLS.—F. ELIZONDO, Chucho de Pueblo Nuevo, Cuba. The principle underlying this invention consists in the use of two conveyors, one of which travels continuously and is driven in unison with the mill, feeding the material thereto directly. The other, which feeds the material to the first conveyors, is driven only intermittently to replenish the supply whenever necessary. To accomplish this automatically the first conveyor is movable vertically by the weight of the material resting thereon, and, according to the rise or fall of said conveyor, the driving mechanism of the second conveyor is thrown into or out of action.

MACHINE FOR CAPPING AND COMPRESSING CANS.—H. L. GUENTHER, Chinook, Wash. Mr. Guenther has invented a machine for capping and compressing cans in such a manner that the can heads are automatically placed in position on the can bodies. The flanges are then double-seamed and rendered completely air-tight without the use of solder, the finished can being automatically removed from the machine.

GARMENT-TURNING APPARATUS.—W. G. JARVIS, Defiance, Ohio. The machine is adapted to reverse gloves, mittens, thumbs and like articles after the same have been sewed wrong side out. It is arranged to efficiently and quickly do its work without danger of tearing or otherwise injuring the article.

CORN OR GRAIN DUMP AND ELEVATOR.—J. MABUS and F. L. HAY, Lilly, Ill. The object of this invention is to provide a machine in which a vehicle containing a load may be driven thereupon and the load dumped and distributed in suitable or desired quantities. The inventors have produced a compact, simple and cheap machine for this purpose.

GRINDING - MILL. — J. BROWN, Lorain, Ohio. This mill is provided with a simple means whereby two grinding surfaces shall be self-tramming or automatically maintained in their proper relations to each other, depending upon the material running through the mill.

CAN-FILLING MACHINE.—L. S. FLECKENSTEIN, Easton, Md. The food is intermittently delivered from a hopper into cans which are successively placed or carried beneath the discharge orifice of the hopper. The distinguishing feature of the machine is the arrangement of reciprocating pistons in a rotatable hopper, the pistons being reciprocated and the cylinder containing them rotated alternately by means of a suitable mechanism, and the food being received and discharged continuously.

TENSION MECHANISM FOR THE LOWER THREADS OF SEWING-MACHINES.—G. G. BEITZEL, 23 Nörrebrogade, Copenhagen, Denmark. The spool upon which the lower thread is wound is placed inside a spool-house consisting of two flat cups. The thread passes out between the rims and is held fast when the cups are pressed together. The spool-house is placed in the catcher of the machine so that the rims of the cups are forced together under an elastic pressure. Means are provided for releasing the pressure when the loop of the upper thread is to be slipped around the spool-house.

LOG-TURNER.—T. H. DILLON, Leesville, La. The invention relates to improvements in machines for turning logs on a sawmill carriage and provides a machine that will operate rapidly without jar to turn either round or square timber. The construction is such that the turner will bear evenly and yieldingly against the log.

COIN-CONTROLLED VENDING MACHINE.—F. LYNES, Johnstown, N. Y. The machine is adapted to contain articles of given values or grades and will deliver an article from any desired one of the several receptacles upon the insertion of a coin, directing the money by means of a novel device to the controlling mechanism for the desired receptacle.

Vehicles and Their Accessories.

CONTROLLER FOR ELECTRIC VEHICLES.—A. L. SIMPSON and H. B. PALMER, New York, N. Y. These inventors have produced a neat and compact controller capable of handling any sort of electrically-propelled vehicles, the action of the same being to avoid the injurious effects of heavy currents, to enable the vehicle to be reversed by merely pressing a button, and to speed the motor to four different rates of travel.

COMBINED POLE-STRAP AND COLLAR-BUCKLE.—A. C. BUTTMAN, Columbus City, Iowa. The buckle which is light and durable is especially adapted for use in connection with pole-straps and billets from collars of harness to effect a ready and convenient attachment between the pole and the collars of harness.

AUTOMOBILE.—A. L. SIMPSON and H. B. PALMER, New York, N. Y. The improvement relates to automobiles of the type employing storage batteries. The battery is carried upon the body of the vehicle and the motor is suspended below. By means of an adjustable brace the motor is prevented from swinging and the gearing is maintained in its proper relation. When the storage battery is exhausted the motor may be connected to a gas engine and operated as a dynamo until the batteries are properly charged. In order to prevent the wheels of a vehicle from turning during this operation the adjustable brace is shortened, thus permitting the gearing to be quickly disconnected.

AXLE-SKEIN.—H. FOWLER, Crandall, Ind. Means are provided in this invention for taking up the space worn away from axles, so that an axle, although it may be partly worn away, may nevertheless be repaired so as to operate effectively.

Miscellaneous Inventions.

TOY.—H. A. VANDER COOK, Chicago, Ill. The toy is arranged to represent a series of animals or figures, passing into an ark, house, or other building, thus affording amusement as well as being instructive.

FOLDING BED.—C. P. BROWN, Springlake, Mich. This folding bedstead is formed principally of cylindrical rods of metal having novel details of construction which adapt it for convenient manipulation to open or close it. It is rendered safe in use by the provision of means to lock the folding section in open condition. A self-adjusting canopy is provided for the bed, which frame extends over the couch when the latter is in a horizontal position.

COMBINED AWNING FRAME AND HOOD.—W. G. BUSCHEMEYER, Louisville, Ky. The awning frame is designed to permit the convenient application of awning fabric thereto, and is so arranged that when raised the entire frame and covering are lifted above the window opening. On the upper portion of the awning frame is an overhanging hood for the protection of an opening at the top of the awning that affords means for escape of heat and provides ventilation.

COMBINED SCALE AND PENHOLDER.—P. F. M. BURROWS, Hunterville, New Zealand. Mr. Burrows has designed in this invention a very convenient attachment for pen and pencil holders, which attachment may be used in weighing letters or like packages.

TOOTH AND BASE FOR PHOSPHATE-LOGS.—E. E. CLINE, Ocala, Fla. The invention relates to a tooth of the kind used upon rotating logs for working phosphate and to a base for supporting this tooth upon the logs. The bases and teeth are arranged spirally so that when the log is rotated and phosphate and water are poured into one end of the trough the action of the teeth is to agitate the mixture, gradually working the phosphate to a particular end of the log.

BOEHM FLUTE.—E. P. ROGERS, Brooklyn, N. Y. This flute relates to the style known among musicians as "Boehm" flutes. The object of the improvement is to increase the number of notes which can be played upon the flute without injuring their purity and richness.

SHOW-CASE.—A. REINLE, Baltimore, Md., A novel construction is provided for uniting the adjoining plates of the so-called "all-glass" show-cases. The fastening device may be applied to secure two plates of glass regardless of the angle of such plates to each other.

COMPOSITION FOR PROTECTING GROWING PLANTS.—J. W. WHITE, Wisner, Neb. This composition is used for protecting young plants, etc., from the attacks of insects and the like, and also for strengthening them against storms and droughts. The preparation consists of the following ingredients: Ordinary clay, 128 ounces; common salt, 1 ounce; eucalyptus fluid, 1 pint; naphthalene moth balls, 24.

ROASTER.—W. F. COLLEY, Dublin, Ga. Mr. Colley has invented an improved device for roasting coffee beans, peanuts, and the like. The roaster may be placed upon an ordinary stove to receive the heat therefrom, and will uniformly roast and clean the coffee beans.

CAN.—E. A. NUGENT, Unionville, N. Y. A simple device is provided for holding the cover on a can or jar. A packing device that will serve to permit an easy removal of the cover is also employed.

EGG-CRATE.—H. J. HAGESTAD, Ettrick, Wis. The crate comprises a frame in which a number of drawers are mounted to slide. In each drawer a filler for the eggs is located. Suitable looking devices hold the drawers in place.

DUPLEX WAFER.—G. A. BARTH, Stapleton, N. Y. The wafer is more especially designed for conveniently and quickly fastening two sheets of paper together, and will permit of separating the sheets without danger of tearing or mutilating the same.

Designs.

MEDALLION.—C. W. PARK, New York, N. Y. The leading feature of the design consists in the opposing decorative figures appearing on the face of the medallion near the top and near the bottom, each of which figures comprises a curved base line terminating in oppositely-curved C-scrolls and the central V-scroll, at the fork of which a trefoil figure is seen.

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Smooth, soft and tough castings. Atlantic Foundry, Phillipsburg, N. J.

Inquiry No. 2565.—For manufacturers of printing outfits for papers and books.

Sawmill machinery and outfits manufactured by the Lane Mfg. Co.. Box 13, Montpelier, Vt.

Inquiry No. 2566.—For the makers of the Garvey ball-bearing spring motor.

FOR SALE.—U. S. 1902 latest beautiful patent on bicycle. For particulars address Tarzian Brothers, Paterson, N. J.

Inquiry No. 2567.—For makers of invalid chairs propelled with power.

We design and build special and automatic machinery for all purposes. The Amstutz-Osborn Company, Cleveland, Ohio.

Inquiry No. 2568.—For makers of toy moving picture machines which have pictures printed on cards and worked by a crank.

WANTED.—Automobile; will exchange new 25-foot torpedo stern launch. Address Matthews & Co., Bascom, Ohio.

Inquiry No. 2569.—For dealers in lead grids for making storage batteries.

Machine Work of every description. Jobbing and repairing. The Garvin Machine Co., 149 Varick, cor. Spring Sts., N. Y.

Inquiry No. 2570.—For machinery for making fur hats.

Designers and builders of automatic and special machines of all kinds. Inventions perfected. The W. A. Wilson Machine Company, Rochester, N. Y.

Inquiry No. 2471.—For dealers in hard paper board slabs for painting with oil paint.

Manufacturers of patent articles, dies, stamping tools, light machinery. Quadriga Manufacturing Company, 18 South Canal Street, Chicago.

Inquiry No. 2572.—For makers of rubber balloons.

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Refrigerating Machine Company. Foot of East 138th Street, New York.

Inquiry No. 2573.—For parties to make glass balls ¾ to ⅛ diameter.

IDEAS DEVELOPED.—Designing, draughting machine work for inventors and others. Charles E. Hadley, 584 Hudson Street, New York.

Inquiry No. 2574.—For machinery for making pearl buttons and novelties.

Manufacturers of slot machines, vending of every description, bar supplies and novelties. Send illustration with lowest cash price, f. o. b. New York. Large quantities. J. Landes, 108 Pitt Str., Sydney, Australia.

Inquiry No. 2575.—For parties engaged in bending wire or making pins of odd shape.

FOR SALE.—A plot of ground containing approved cement rock. Located two miles north of Richland Station, P. and R. R.R., Leb. Co., Pa., at a point where Berks and Dauphin Turnpike, Old Union Canal and Tulpehocken Creek are contiguous. This rock was found 1827. Engineer Guilford, then of Lebanon, found it in building the now abandoned Union Canal. The "block cement rock" furnished the material by which to build the locks, which to-day *prove* the article. A branch railroad from station to stone quarry about one-quarter mile from plot is now in use. Water and limestone close at hand. For view of blue print plot, noting the five test borings and analysis of cement rock, call on

H. Mosser,
Washington Street, Reading, Pa.

Inquiry No. 2576.—For dealers in second-hand foot presses for die work, etc.

Information about Corporations.—Business Corporations, their incorporation, organization and procedure. Send for our new list of practical corporation books, blanks and materials. The Ronald Press, 170 B'way.

Inquiry No. 2577.—For parties to make stoppers out of pure paper.

Inquiry No. 2578.—For makers of paper bags of different sizes.

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Inquiry No. 2584.—For commutators or segments for small machines.

Inquiry No. 2585.—For the makers of art pillow tops and Rajah portieres.

Inquiry No. 2586.—For dealers in electric lighting plants.

Inquiry No. 2587.—For a small kerosene motor for a launch.

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Inquiry No. 2589.—For rolling mills to roll steel coated with tin for a special purpose.

Inquiry No. 2590.—For machinery and necessary outfit for making wooden buckets.

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Inquiry No. 2592.—For makers of excavators, Lowrie's preferred.

Inquiry No. 2593.—For machinery to make coal briquettes.

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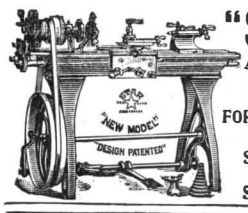

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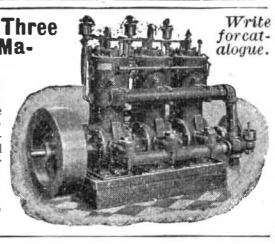

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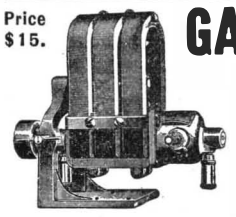

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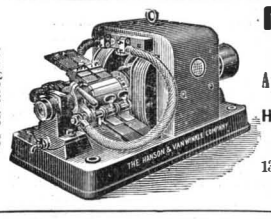

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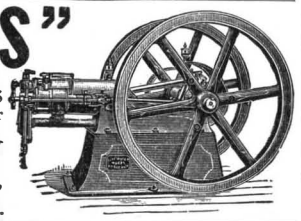

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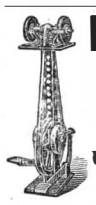

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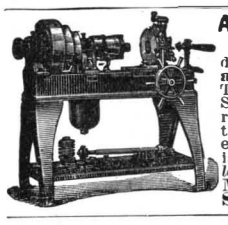

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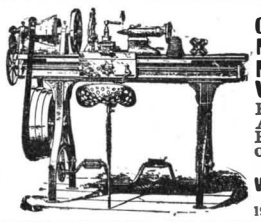

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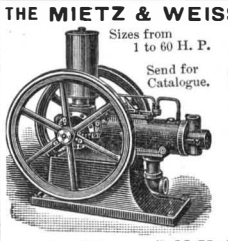

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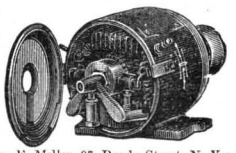

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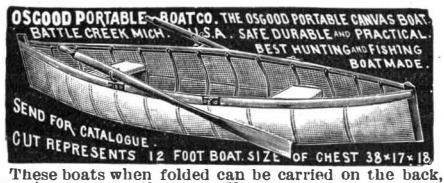

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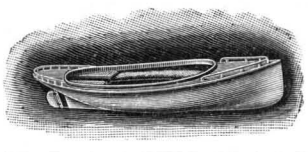

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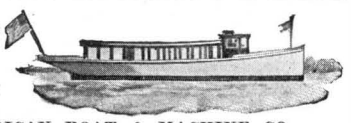

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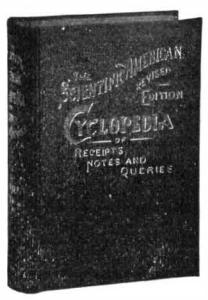

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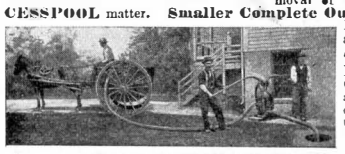

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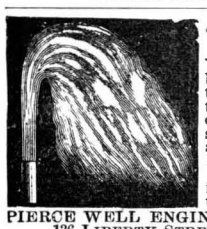

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Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.
References to former articles or answers should give date of paper and page or number of question.
Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.
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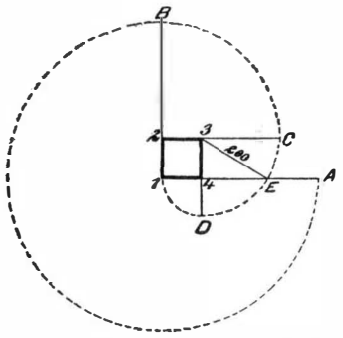
Minerals sent for examination should be distinctly marked or labeled.

(8605) A. K. M. asks: 1. Can you let me know the cheapest and most simple way of producing oxygen? A. Oxygen is generated by heating a mixture of manganese dioxide and potassium chlorate in a metal flask. Care is necessary in doing this not to disengage the gas too rapidly and thus produce an explosion of the apparatus. The materials also should be tested in advance to see that they will give up the oxygen quietly and not too rapidly. 2. Can you explain what caused electric sparking at point of connecting 3-inch suction pipe let in from top of tank car containing a mixture of turpentine and naphtha, the discharge pipe from pump leading to large storage tank of several thousand barrels of the same mixture? Also being connected with large storage tanks of gasoline and carbon oil. The suction pipe being of iron, every attempt made to connect would cause heavy sparking, so that the men dared not connect for fear of fire, the temperature being about 15 deg. Fahr., having had cold weather for some time; whereafter the men got a suction pipe of galvanized iron, let it down into the tank car, and in connecting there was no more sparking. A. The charge of electricity was due probably to the very cold air and friction of the pipe and pump. If the liquid was not set on fire by the sparks which passed while the men held the pipe near the tank, it could not have been after they had brought the ends into connection with each other. The danger would then have been over. These oils are not conductors of electricity.

(8606) E. E. R. asks: I would like to have you publish this problem in your query column: A calf is tied with 400 feet of rope to the corner of a barn 100 feet square. How many square rods can the calf graze over? A. Let the barn be represented by the square 1-2-3-4. Tie the rope at 1. (1) The calf can swing from *A* to *B*, grazing over three-quarters of a circle whose radius is 400 feet, the full length of the rope. (2) Beyond *B* to the right



his rope shortens to 300 feet, and he grazes over one-fourth of a circle whose radius is 300 feet. (3) Again his rope shortens to 200 feet with the center at 3, and he grazes around till he covers one-fourth of a circle with a radius of 200 feet; but a part of this is included in the area already covered. (4) To find this part draw the line 3-*E*, forming the triangle 3-4-*E*. By trigonometry we find that the angle 3 in this triangle is 60 deg. Hence the angle *C*-3-*E* is 30 deg., and the sector of which this is the angle is 1-12 of a circle whose radius is 200 feet. (5) Compute the area of the triangle 3-4-*E* by the ordinary rule for right angled triangles, and find the total area grazed over by adding the several areas described above.

(8607) E. E. S. asks: 1. What is the best way to mount a map on a muslin backing, and would a window shade be suitable? A. Moisten the muslin, stretch and tack it down on a table. Then wet the map thoroughly and apply the paste evenly over the entire back of the map, being very careful to bring it to the edges of the paper. Now lay the sheet on the cloth and smooth it out and rub it down upon the cloth so as to remove air bubbles and bring it into contact with the cloth. A roller or squegee such as is used for mounting photographs will enable you to do the job much better. 2. How can I produce on brass the bronze-like finish used on the instruments of surveyors and engineers? A. Bronzing of brass by dipping in a solution of 5 drachms of perchloride of iron to 1 pint of water, until the desired color is obtained: then wash in hot water, dry, and lacquer with a thin shellac and alcohol varnish.

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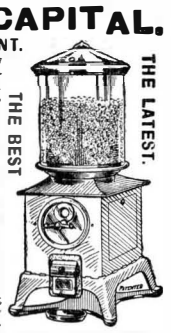

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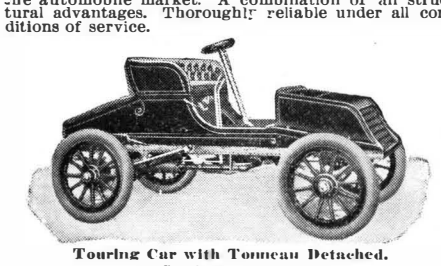

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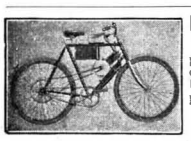

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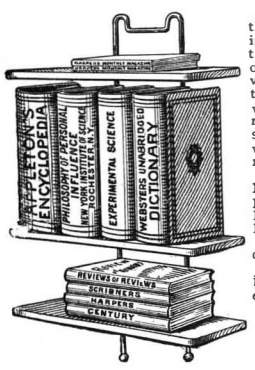

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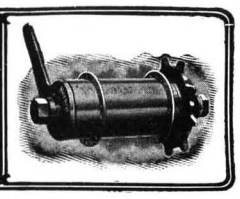

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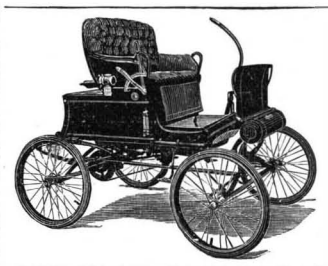

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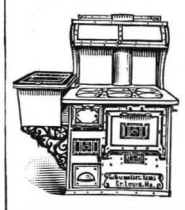

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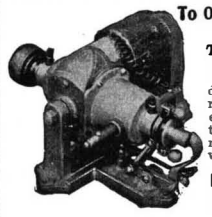

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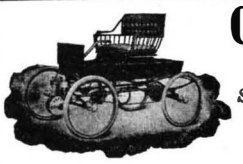

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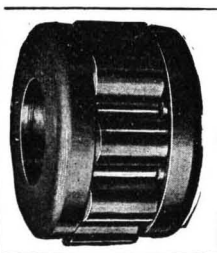

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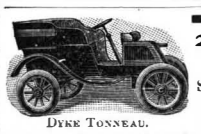

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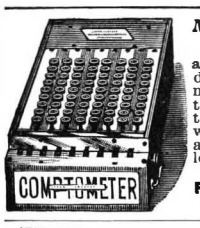

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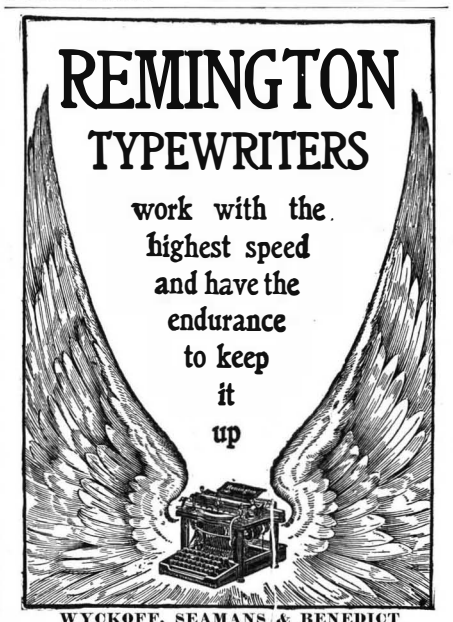

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